ATTACHMENT I

FEMA IN-RESIDENCE SHELTER DRAWINGS

IN–RESIDENCE SHELTER

INDEX OF DRAWINGS	DRAWING NO.	SHEET NO.	REVISION NO.
GENERAL NOTES	2	SHEET 2 OF 16	1
IN–GROUND SHELTERS–SECTIONS AND DETAILS	IG–1	SHEET 3 OF 16	
BASEMENT LEAN–TO	B–1	SHEET 4 OF 16	1
BASEMENT SHELTER–CORNER LOCATION	B–2	SHEET 5 OF 16	1
CMU/CONCRETE ALTERNATIVE PLANS	AG–1	SHEET 6 OF 16	1
CMU/CONCRETE WALL SECTIONS	AG–2	SHEET 7 OF 16	
CMU/CONCRETE SECTIONS CEILING ALTERNATIVES	AG–3	SHEET 8 OF 16	1
WOOD–FRAME SHELTER PLAN–PLYWOOD SHEATHING W/CMU IN–FILL	AG–4	SHEET 9 OF 16	1
WOOD–FRAME SHELTER PLAN–PLYWOOD AND STEEL WALL SHEATHING	AG–5	SHEET 10 OF 16	1
WOOD–FRAME SHELTER–FOUNDATION SECTIONS	AG–6	SHEET 11 OF 16	1
INSULATING CONCRETE FORM–PLANS	AG–7	SHEET 12 OF 16	NEW
INSULATING CONCRETE FORM–SECTIONS	AG–8	SHEET 13 OF 16	NEW
MISC. DETAILS	14	SHEET 14 OF 16	1
MATERIALS LISTS	15&16	SHEET 15&16 OF 16	1

LIMIT OF LIABILITY:

The designs in this booklet are based on extensive research of the causes and effects of windstorm damage to buildings. Shelters designed and built to these designs should provide a high degree of occupant protection during severe windstorms (hurricanes and tornadoes.) Any substitution of either materials or design concepts may decrease the level of occupant protection and/or increase the possibility of personal injury during a severe wind event.

Because it is not possible to predict or test all conditions that may occur during severe windstorms, or control the quality of construction, among other things, the designer does not warrant the design.

The designer neither manufactures nor sells shelters built from this design. The designers have not made and do not make any representation, warranty, or covenant, express or implied, with respect to the design, condition, quality, durability, operation, fitness for use, or suitability of the shelter in any respect whatsoever. Designers shall not be obligated or liable for actual, incidental, consequential, or other damages of or to users of shelters or any other person or entity arising out of or in connection with the use, condition, and/or performance of shelters built from this design or from the maintenance thereof.

INDEX SHEET

DRAWING NO.: 1	SHEET 1 OF 16
DATE: OCTOBER 1998	
REVISED: AUGUST 1999	REV. NO. 1

FEDERAL EMERGENCY MANAGEMENT AGENCY
MITIGATION DIRECTORATE WASHINGTON, DC

IN–RESIDENCE SHELTER

GENERAL NOTES

1. CONCRETE:
   A. ALL CONCRETE SHALL HAVE STONE AGGREGATE (NORMAL WEIGHT). 28-DAY COMPRESSIVE STRENGTH (f'c) SHALL BE 3000 PSI MINIMUM FOR CAST-IN-PLACE CONCRETE.
   B. REINFORCING BARS SHALL BE MILD STEEL WITH A MINIMUM YIELD STRENGTH OF 60 KSI.
   C. REINFORCING BAR PROTECTION:
      1. CONCRETE PLACED AGAINST EARTH . . . . . 3"
      2. CONCRETE PLACED IN FORMS . . . . . 1-1/2"
   D. REINFORCING BAR PLACMENT TOLERANCE IS 1/2" IN ANY DIRECTION.
   E. SPLICING OF REINFORCEMENT IS NOT PERMITTED EXCEPT AS SHOWN ON THE DRAWINGS. BARS SHALL BE LAP SPLICED AT ALL CORNERS. SPLICE LENGTHS AS FOLLOWS:
      1. #4 BARS . . . . . 24"
      2. #5 BARS . . . . . 30"
   F. WELDED WIRE REINFORCEMENT: LAP ONE AND ONE-HALF MESH SPACES AT SPLICES AND WIRE IN CONTACT.
   G. FIELD WELDING OF REINFORCEMENT IS NOT PERMITTED.
   H. ALL REINFORCING BAR BENDS SHALL BE MADE MECHANICALLY. HEAT-BENDING IS NOT PERMITTED.

2. MASONRY:
   A. MASONRY UNITS SHALL DEVELOP ULTIMATE COMPRESSIVE STRENGTH (f'm) OF 1500 PSI AT 28-DAYS.
   B. MORTAR TO BE TYPE M OR S PER ASTM C270-97
   C. REINFORCING BARS SHALL BE MILD STEEL WITH A MINIMUM YIELD STRENGTH OF 60 KSI.
   D. REINFORCING BAR PLACEMENT TOLERANCE IS 1/2" IN ANY DIRECTION.
   E. SPLICING OF REINFORCING BARS IS NOT PERMITTED EXCEPT AS SHOWN ON THE DRAWINGS. SPLICE LENGTHS AS FOLLOWS:
      1. #4 BARS . . . . . 24"
      2. #5 BARS . . . . . 30"
   F. HORIZONTAL TRELLIS (WIRE) REINFORCEMENT INSTALLED AT EVERY OTHER COURSE: LAP ONE AND ONE-HALF MESH SPACES AT SPLICES AND AT CORNERS.

3. WOOD:
   A. FRAMING LUMBER TO HAVE MODULUS OF ELASTICITY = 1,200,000 PSI MIN. AND F_b = 850 PSI MIN. FOR NORMAL DURATION LOADING. EXAMPLES OF ACCEPTABLE GRADE AND SPECIES OF FRAMING LUMBER INCLUDE #2 AND BETTER SOUTHERN PINE, DOUGLAS FIR, HEM-FIR, AND SPRUCE - PINE - FIR.
   B. PLYWOOD TO BE RATED SHEATHING SPAN RATING 24/16, MIN. 23/32 THICKNESS.
   C. ALL WOOD SILL PLATES TO BE .40 CCA P.T. LUMBER.
   D. NAILS TO BE COMMON WIRE NAILS.

4. COLD-FORMED (LIGHT-GAUGE) STEEL SHEATHING:
   A. YIELD STRENGTH FOR METAL IS 36 KSI MINIMUM.
   B. ALL METAL SHALL BE G60 GALVANIZED BY THE MANUFACTURER.

5. THE CONTRACTOR SHALL VERIFY AND COORDINATE ALL DIMENSIONS AND QUANTITIES PRIOR TO STARTING CONSTRUCTION.

6. THE CONSTRUCTION DRAWINGS SHALL NOT BE SCALED. DIMENSIONS APPLY.

7. IF THERE IS A CONFLICT AMONG THE GENERAL NOTES, SPECIFICATIONS, AND PLANS, THE ORDER OF PRECEDENCE IS NOTES, THEN SPECIFICATIONS, THEN PLANS.

8. THE CONSTRUCTION DRAWINGS REPRESENT THE FINISHED STRUCTURE. THE CONTRACTOR IS SOLELY RESPONSIBLE FOR PROVIDING ALL MEASURES NECESSARY TO ENSURE THAT THE STRUCTURE IS PROTECTED DURING CONSTRUCTION. THESE MEASURES INCLUDE (BUT ARE NOT LIMITED TO) SHORING AND BRACING FOR CONSTRUCTION LOADS AND WORKER SAFETY PURPOSES.

10. FOLLOW MANUFACTURER'S RECOMMENDATION'S FOR NAILING REQUIREMENTS OF UPLIFT/SHEAR RESISTANCE CONNECTORS.

11. ALL PLYWOOD JOINTS SHOULD BE SOLIDLY BLOCKED W/2X4'S

12. WALL & CEILING PENETRATIONS THROUGH THE MISSILE PROTECTION SHEATHING ARE TO BE MINIMIZED.

13. CONDUIT & OTHER VERTICAL RUNS IN WALLS SHOULD BE COLLECTED AND RUN IN THE CHASE.

14. DO NOT DRILL THROUGH WALL STUDS OR TOP AND BOTTOM PLATES FOR PLUMBING SUPPLY LINES OR VENTS. INSTALL ALL PLUMBING SUPPLY LINES AND VENTS IN PLUMBING CHASE.

15. VENTILATION IS TO BE PROVIDED IN ACCORDANCE WITH THE LOCAL BUILDING CODE. VENTILATION MAY BE EITHER NATURAL OR MECHANICAL SUCH THAT MINIMUM VENTILATION IS 0.5 AIR CHANGES / HOUR.

16. THE DESIGNS SHOWN ARE COMPLIANT WITH THE 1997 NEHRP RECOMMENDED PROVISIONS.

17. TO ENSURE THE SHELTER PROVIDES THE DESIRED LEVEL OF PROTECTION, A PROFESSIONAL ENGINEER OR ARCHITECT MUST BE CONSULTED FOR ANY DESIGN CONDITIONS FOUND TO BE DIFFERENT FROM THOSE REPRESENTED BY THESE PLANS.

18. SEE SHEETS 15 AND 16 OF 16 FOR THE MATERIAL LIST FOR EACH SHELTER DESIGN.

19. TO OBTAIN AN EQUIVALENT LEVEL OF PROTECTION, SHELTER DESIGNS NOT MEETING THE SPECIFIC REQUIREMENTS OF THE DESIGNS IN THESE PLANS SHOULD BE DESIGNED TO MEET THE "NATIONAL PERFORMANCE CRITERIA FOR TORNADO SHELTERS" AVAILABLE AT THE FEMA WEBSITE AT http://www.fema.gov/library/npc_ts.htm. THE "NATIONAL PERFORMANCE CRITERIA FOR TORNADO SHELTERS" ALSO PROVIDES ADDITIONAL GUIDANCE ON DESIGNING LARGER PUBLIC SHELTERS.

20. THE DOORS SHOWN IN THESE PLANS WERE LABORATORY-TESTED FOR DEBRIS IMPACT FOR DOOR WIDTHS FROM 2'-6" TO 3'-0". FEMA STRONGLY ENCOURAGES INDIVIDUALS TO USE A MINIMUM DOOR WIDTH OF 2'-8" FOR WHEELCHAIR ACCESS.

DESIGN BASIS

1. LIVE LOADS USED IN DESIGN:
   A. WIND PRESSURES DEVELOPED FROM 250 - MPH 3-SEC. PEAK GUST IN ACCORDANCE WITH ASCE 7-95.
   B. WINDBORNE DEBRIS (MISSILE) IMPACT LOADS CREATED BY A 15-LB. 2X4 TRAVELING HORIZONTALLY AT 100 MPH, TRAVELING VERTICALLY AT 67 MPH, AND IMPACTING NORMAL TO WALL SURFACE.
2. SOIL BEARING CAPACITY OF 2000 PSF MIN. HAS BEEN ASSUMED.

ABBREVIATIONS

A.B.	– ANCHOR BOLT
CMU	– CONCRETE MASONRY UNIT
CONC.	– CONCRETE
DBL.	– DOUBLE
DIA.	– DIAMETER
E.W.	– EACH WAY
GA.	– GAUGE
GYP.	– GYPSUM
ICF	– INSULATING CONCRETE FORMS
MAX	– MAXIMUM
MH.	– MANHOLE
MIN.	– MINIMUM
N.T.S.	– NOT TO SCALE
O.C.	– ON CENTER
P.T.	– PRESSURE TREATED
REQD.	– REQUIRED
S.F.	– SQUARE FOOT
SYP	– SOUTHERN YELLOW PINE
TYP.	– TYPICAL
WWF	– WELDED WIRE FABRIC
W/	– WITH

LIMIT OF LIABILITY:

The designs in this booklet are based on extensive research of the causes and effects of windstorm damage to buildings. Shelters designed and built to these designs should provide a high degree of occupant protection during severe windstorms (hurricanes and tornadoes.) Any substitution of either materials or design concepts may decrease the level of occupant protection and/or increase the possibility of personal injury during a severe wind event.

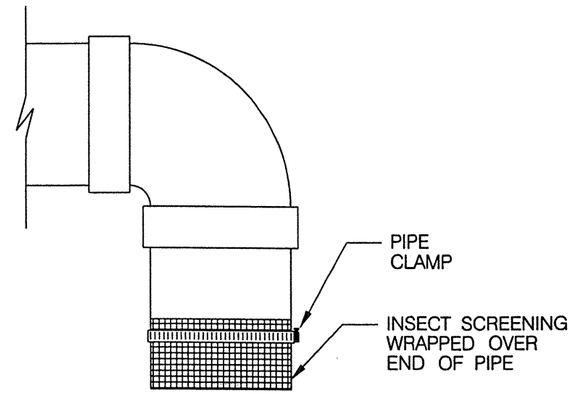
Because it is not possible to predict or test all conditions that may occur during severe windstorms, or control the quality of construction, among other things, the designer does not warrant the design.

The designer neither manufactures nor sells shelters built from this design. The designers have not made and do not make any representation, warranty, or covenant, express or implied, with respect to the design, condition, quality, durability, operation, fitness for use, or suitability of the shelter in any respect whatsoever. Designers shall not be obligated or liable for actual, incidental, consequential, or other damages of or to users of shelters or any other person or entity arising out of or in connection with the use, condition, and/or performance of shelters built from this design or from the maintenance thereof.

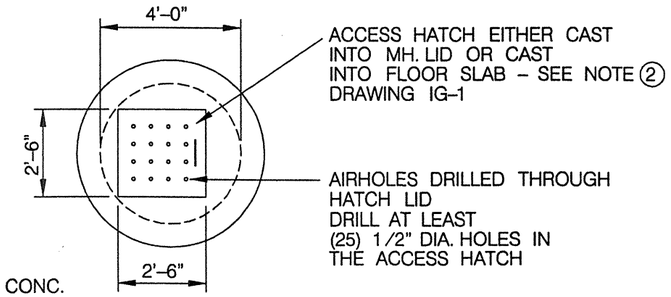
GENERAL NOTES

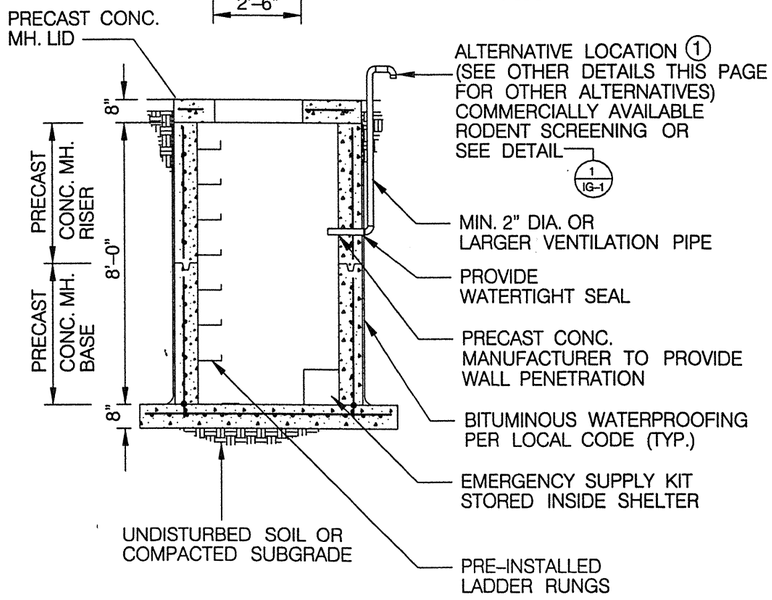
DRAWING NO.: 2	SHEET 2 OF 16
DATE: OCTOBER 1998	
REVISED: AUGUST 1999	REV. NO: 1

FEDERAL EMERGENCY MANAGEMENT AGENCY
MITIGATION DIRECTORATE WASHINGTON, DC

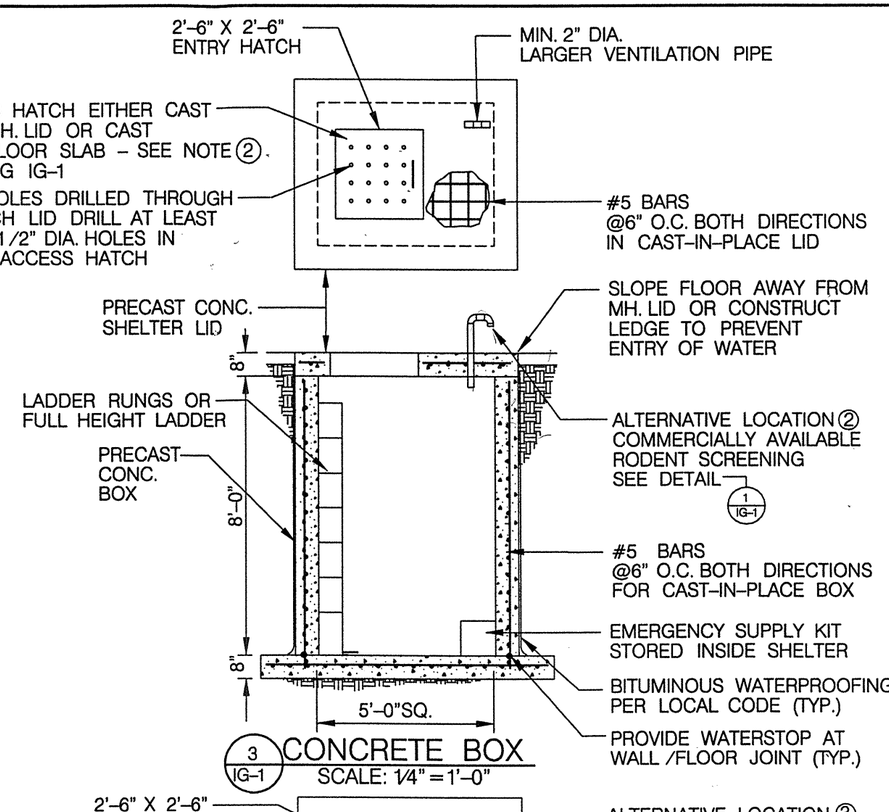


1 IG-1 RODENT SCREENING
SCALE: 1/4" = 1'-0"

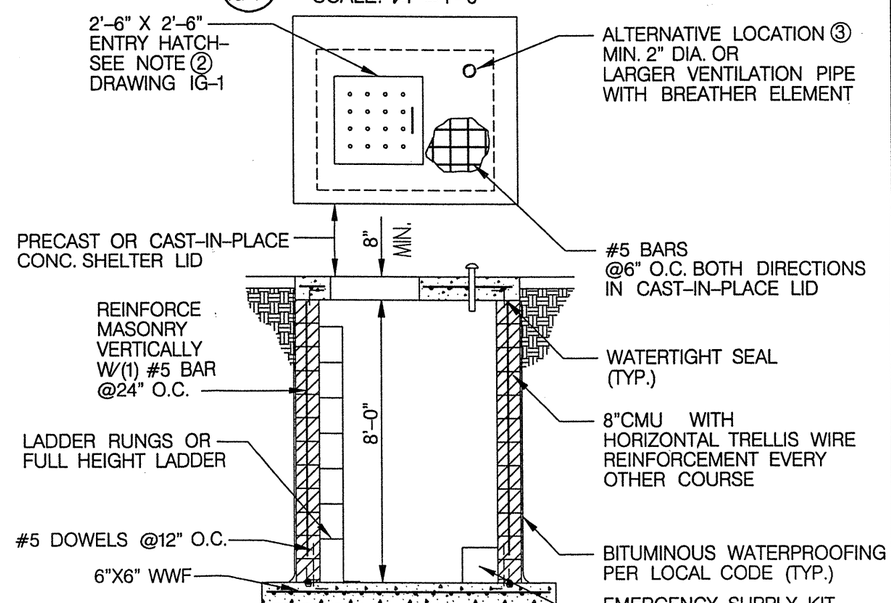




2 IG-1 PRECAST CONCRETE MANHOLE
SCALE: 1/4" = 1'-0"



3 IG-1 CONCRETE BOX
SCALE: 1/4" = 1'-0"



4 IG-1 8" MASONRY BOX SCALE: 1/4" = 1'-0"

NOTES:

1. SPACE REQUIRED INSIDE IN-GROUND SHELTER IS MIN. 5 S.F./ PERSON,
2. MODEL NOS. & MANUFACTURERS FOR HATCH COVERS INCLUDE:

MANUFACTURER	MODEL NO.
ACUDOR	FA150
BILCO	J4AL
BABCOCK-DAVIS	FB4700

NOTES:
BECAUSE NOT ALL CONTRACTORS ARE FAMILIAR WITH THE TYPE OF HATCH COVERS SHOWN IN THESE DRAWINGS, THE NAMES OF SOME COMPANIES THAT MANUFACTURE HATCH COVERS HAVE BEEN INCLUDED IN THIS TABLE. THE LIST OF COMPANIES IS NOT, HOWEVER, EXHAUSTIVE. ADDITIONALLY, THIS LIST IS NOT INTENDED TO EXPRESS A PREFERENCE FOR THOSE MANUFACTURERS AND/OR THEIR PRODUCTS BY THE UNITED STATES GOVERNMENT NOR IS IT AN ENDORSEMENT OF THOSE MANUFACTURERS AND/OR THEIR PRODUCTS.

CAUTION

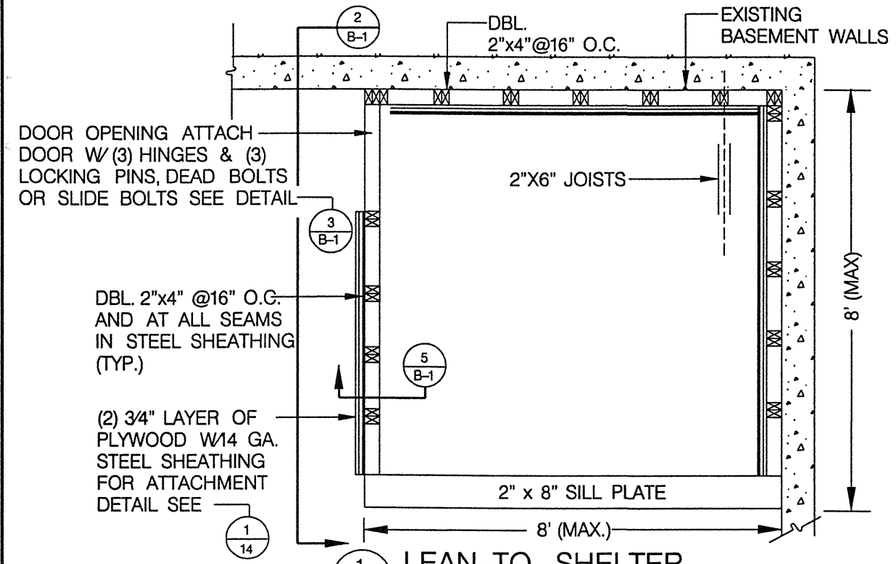
DO NOT INSTALL IN-GROUND SHELTER IN AREAS OF EXPANSIVE CLAY OR HIGH WATER TABLE OR IN AREAS THAT ARE FLOODPRONE.

IN-GROUND SHELTERS– SECTIONS AND DETAILS

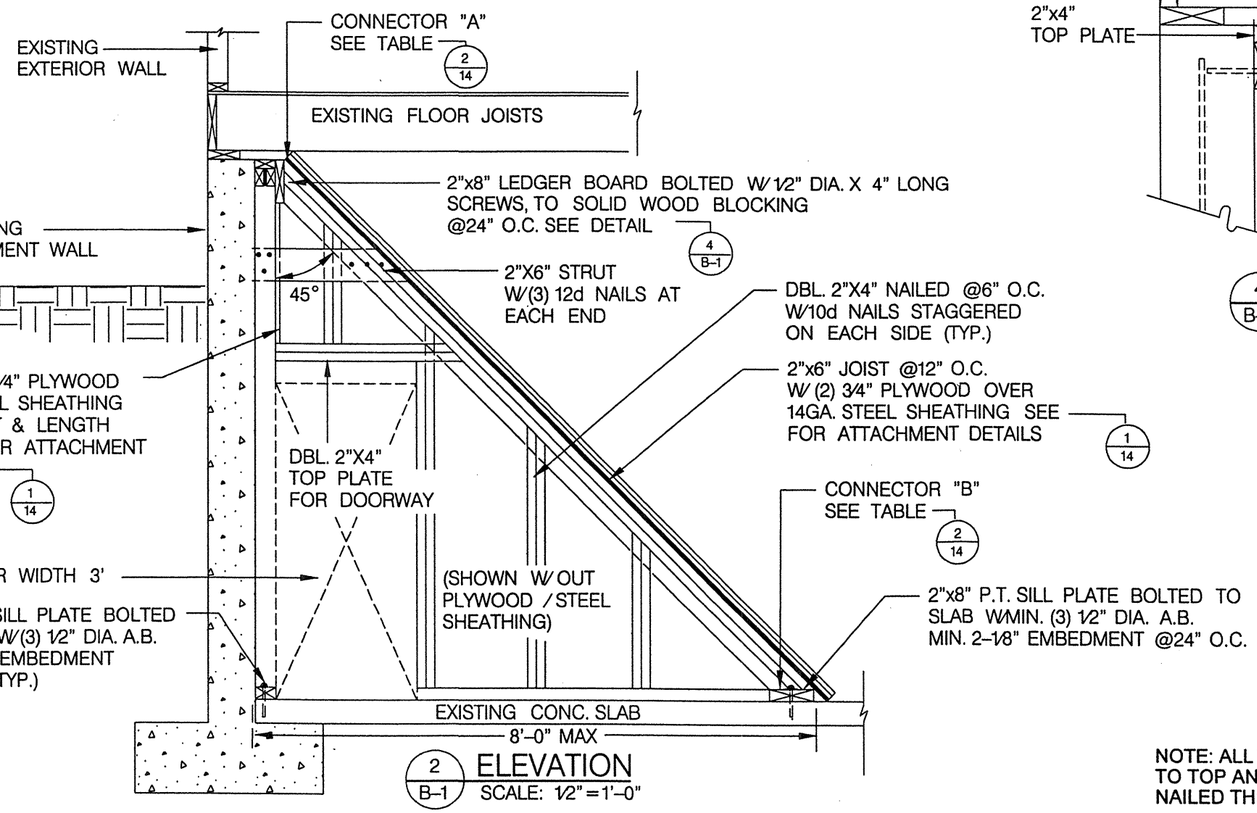
DRAWING NO.: IG-1 | SHEET 3 OF 16

DATE: OCTOBER 1998

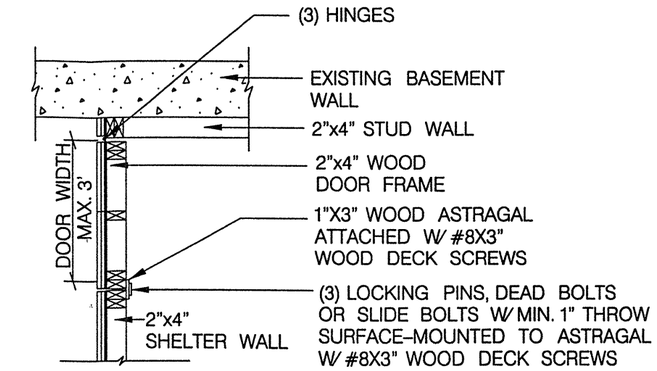
FEDERAL EMERGENCY MANAGEMENT AGENCY
MITIGATION DIRECTORATE WASHINGTON, DC



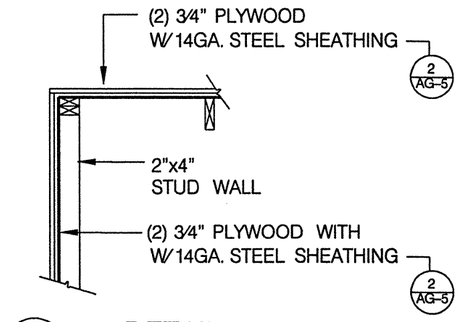
1 B–1 **LEAN–TO SHELTER PARTIAL BASEMENT PLAN**
SCALE: 3/8" = 1'–0"



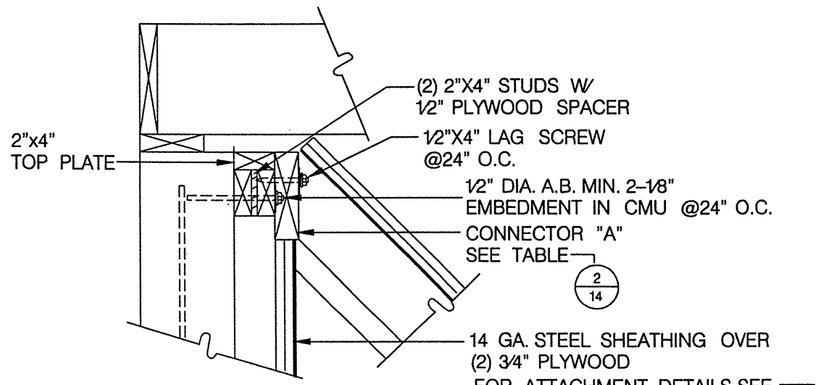
2 B–1 **ELEVATION**
SCALE: 1/2" = 1'–0"



3 B–1 **DOOR FRAMING DETAIL**
TOP VIEW
SCALE: 1/2" = 1'–0"



5 B–1 **DETAIL**
SIDE VIEW
SCALE: 1/2" = 1'–0"



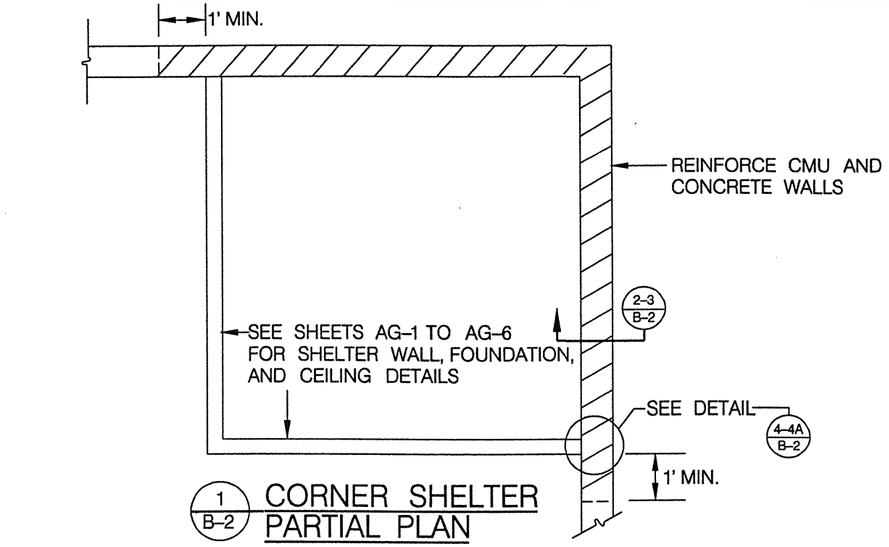
4 B–1 **DETAIL**
SIDE VIEW
SCALE: 1" = 1'–0"

NOTE: ALL WALL STUDS TO BE ATTACHED TO TOP AND BOTTOM PLATES W/ (2) 16d NAILS NAILED THROUGH FROM OUTSIDE

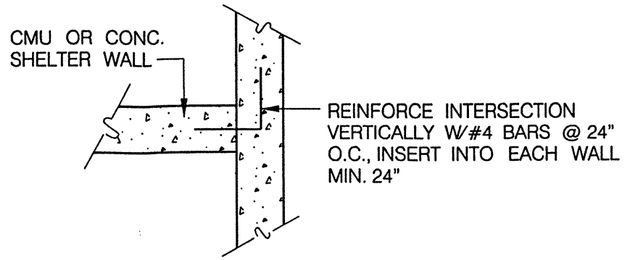
BASEMENT LEAN–TO

DRAWING NO.: B–1	SHEET 4 OF 16
DATE: OCTOBER 1998	
REVISED: AUGUST 1999	REV. NO. 1

FEDERAL EMERGENCY MANAGEMENT AGENCY
MITIGATION DIRECTORATE WASHINGTON, DC

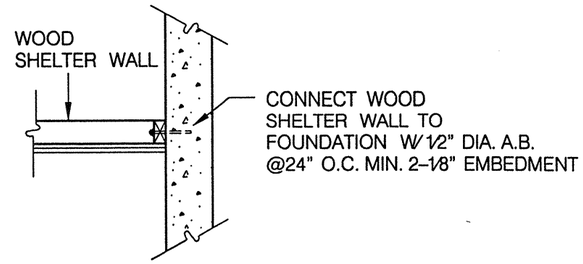


1 / B-2 CORNER SHELTER PARTIAL PLAN



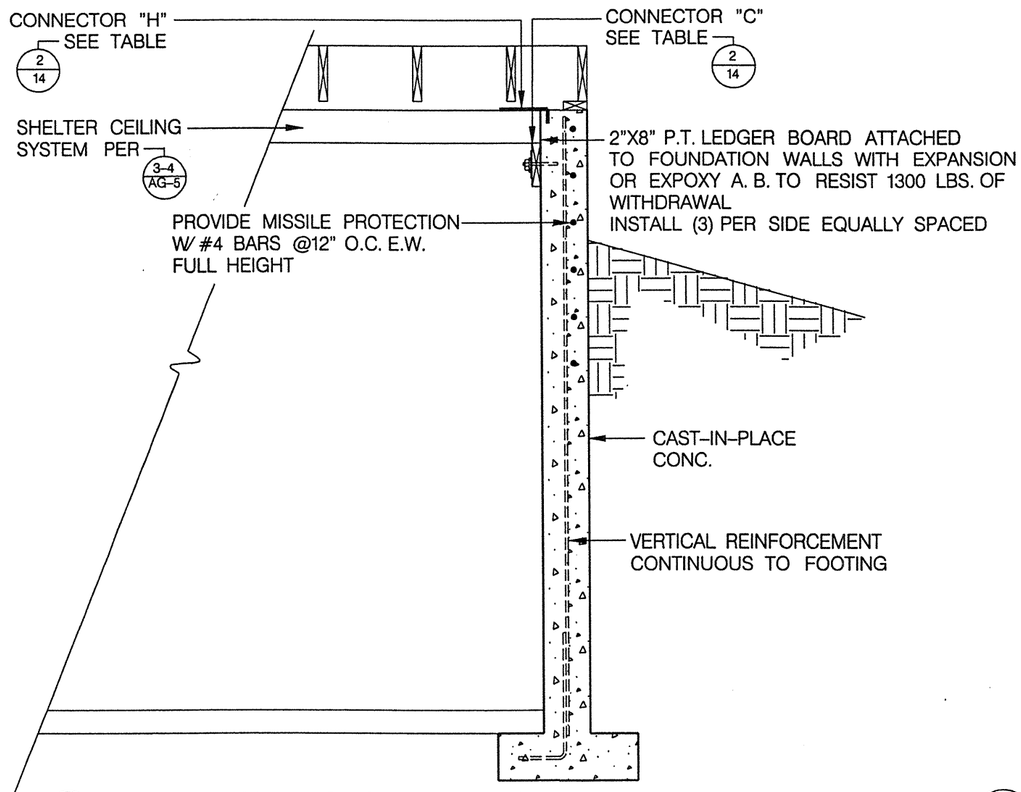
4 / B-2 ALTERNATIVE: CMU SHELTER TO FOUNDATION DETAIL

TOP VIEW
SCALE: 1/2" = 1'-0"



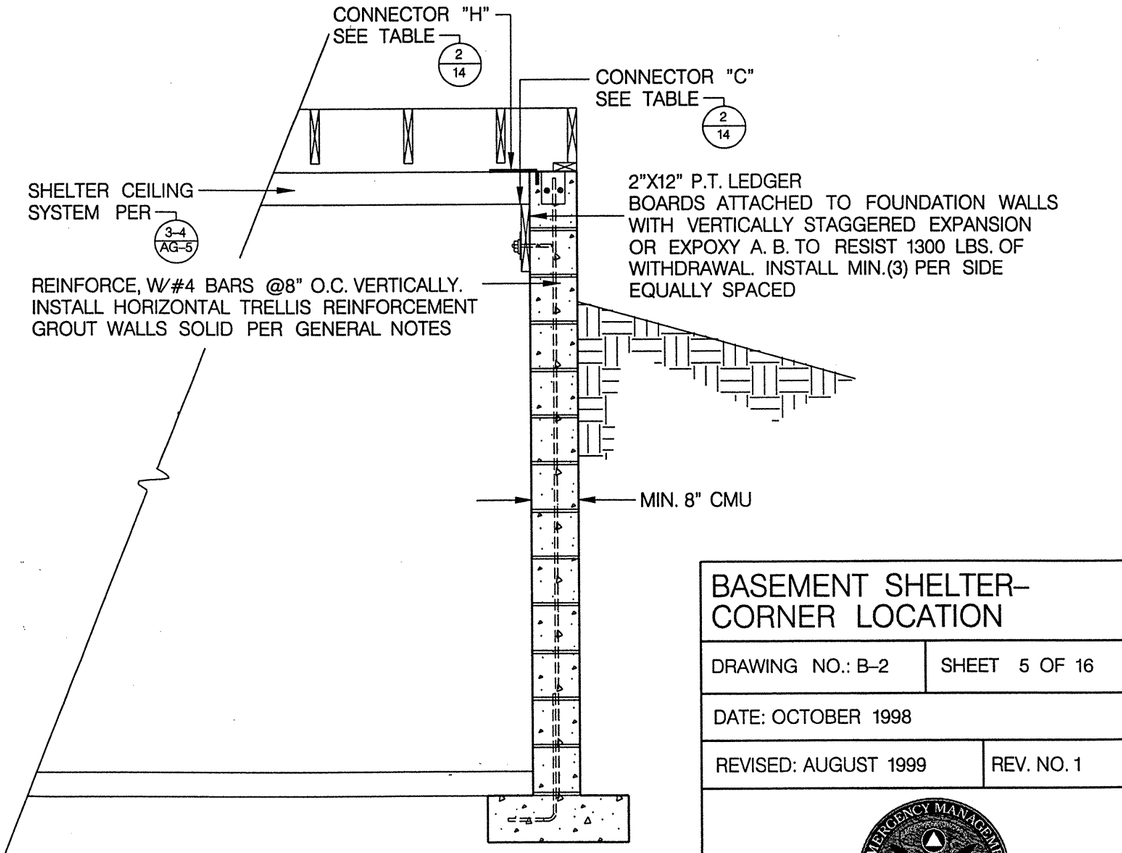
4A / B-2 ALTERNATIVE: WOOD SHELTER TO FOUNDATION DETAIL

TOP VIEW
SCALE: 1/2" = 1'-0"



2 / B-2 ALTERNATIVE: CAST-IN-PLACE CONCRETE FOUNDATION ELEVATION

SCALE: 1/2" = 1'-0"



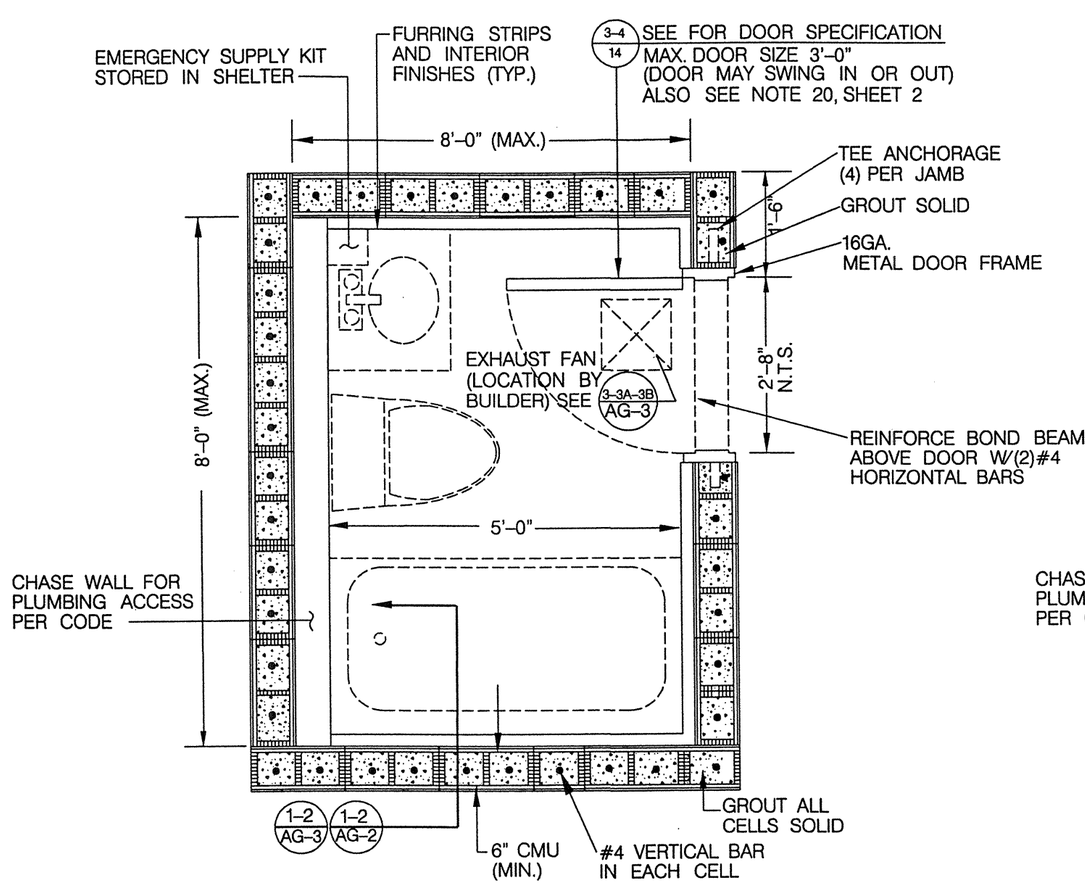
3 / B-2 ALTERNATIVE: CMU FOUNDATION ELEVATION

SCALE: 1/2" = 1'-0"

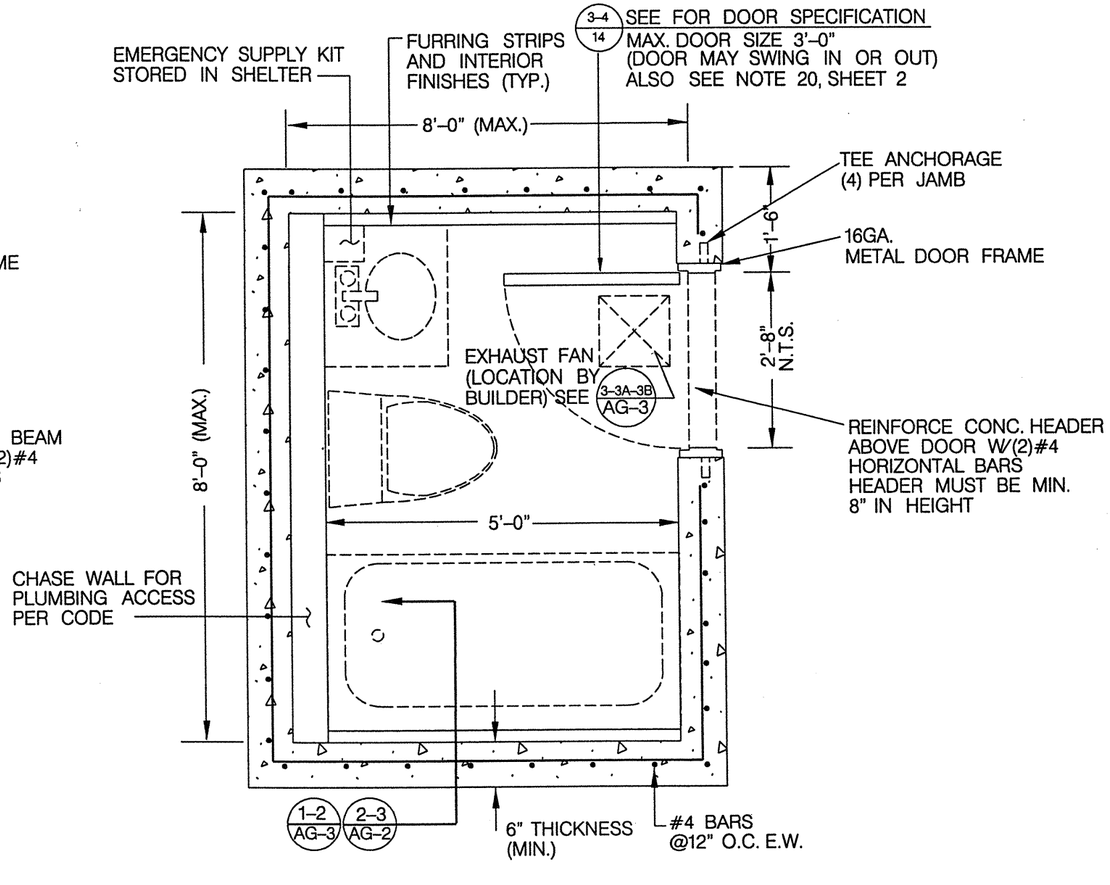
BASEMENT SHELTER– CORNER LOCATION

DRAWING NO.: B-2	SHEET 5 OF 16
DATE: OCTOBER 1998	
REVISED: AUGUST 1999	REV. NO. 1

FEDERAL EMERGENCY MANAGEMENT AGENCY
MITIGATION DIRECTORATE WASHINGTON, DC



1 AG-1 TYPICAL PLAN VIEW (CMU)
(SHOWN AS BATH FOR ILLUSTRATION)
SCALE: 1/2" = 1'-0"



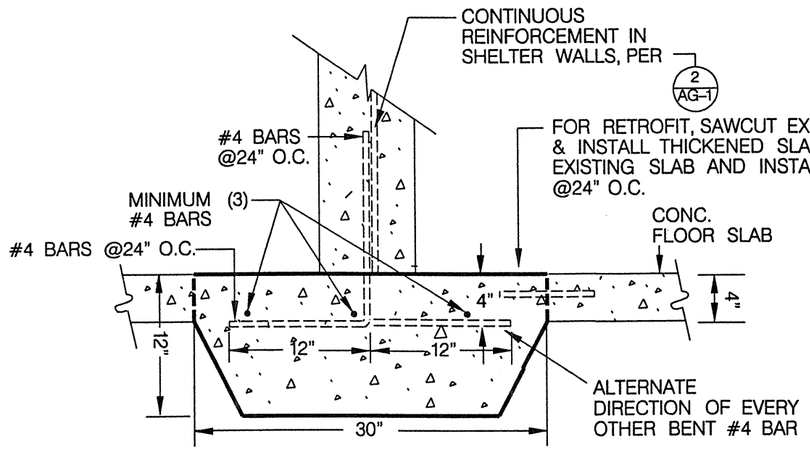
2 AG-1 TYPICAL PLAN VIEW (CONCRETE)
(SHOWN AS BATH FOR ILLUSTRATION)
SCALE: 1/2" = 1'-0"

NOTE: ICF MAY BE USED AS ALTERNATIVE TO CAST-IN-PLACE CONCRETE, SEE SHEETS 12 AND 13

CMU/CONCRETE ALTERNATIVE PLANS

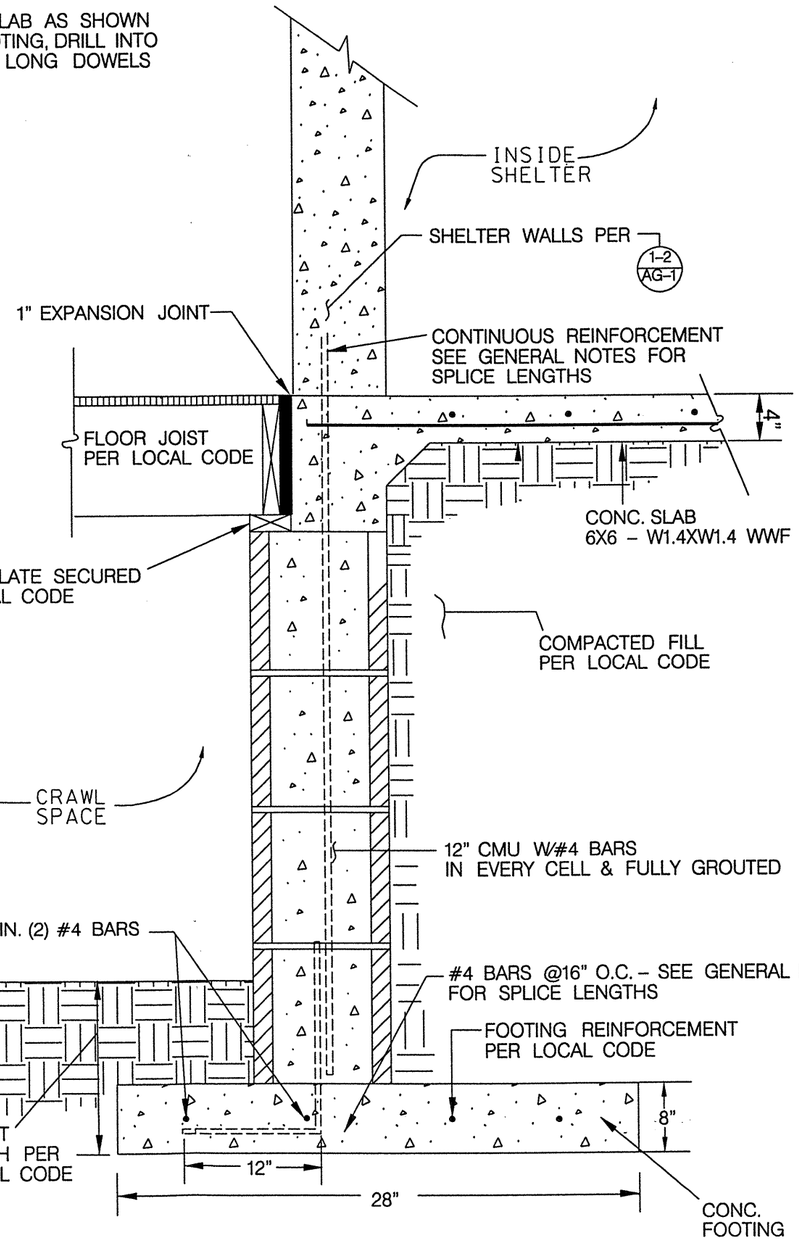
DRAWING NO.: AG-1	SHEET 6 OF 16
DATE: OCTOBER 1998	
REVISED: AUGUST 1999	REV. NO. 1

FEDERAL EMERGENCY MANAGEMENT AGENCY
MITIGATION DIRECTORATE WASHINGTON, DC



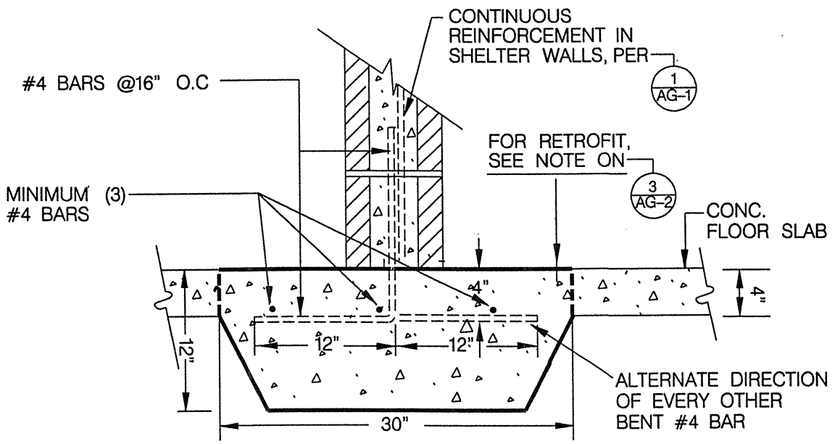
3 AG-2 TYPICAL ANCHOR DETAIL FOR CONCRETE WALL ON SLAB-ON-GRADE FOUNDATION

SCALE: 1" = 1'-0"



2 AG-2 TYPICAL ANCHOR DETAIL FOR CMU WALL CRAWL SPACE FOUNDATION

SCALE:1" = 1'-0"



1 AG-2 TYPICAL ANCHOR DETAIL FOR CMU WALL ON SLAB-ON-GRADE FOUNDATION

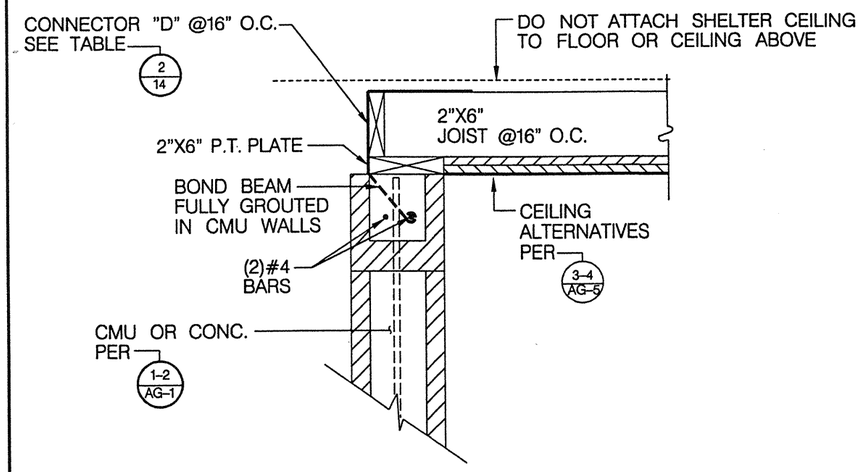
SCALE: 1" = 1'-0"

CMU/CONCRETE WALL SECTIONS

DRAWING NO.: AG-2 | SHEET 7 OF 16

DATE: OCTOBER 1998

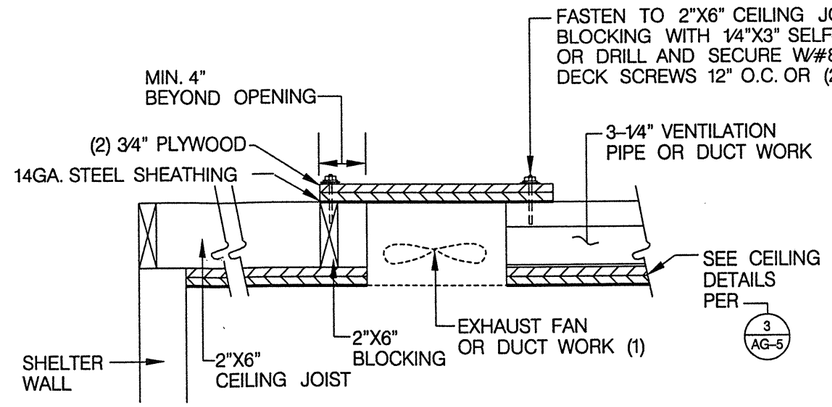
FEDERAL EMERGENCY MANAGEMENT AGENCY
MITIGATION DIRECTORATE WASHINGTON, DC



ALTERNATIVE 1 OF 2

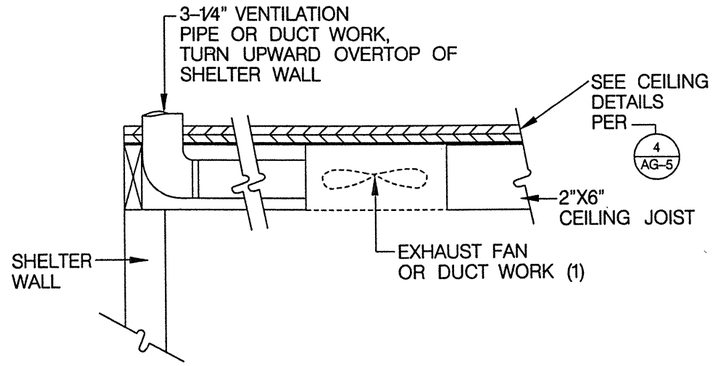
1/AG-3 TYPICAL WALL / CEILING CONNECTION WOOD FRAMING USING EMBEDDED ANCHOR STRAP

SCALE: 1" = 1'-0"



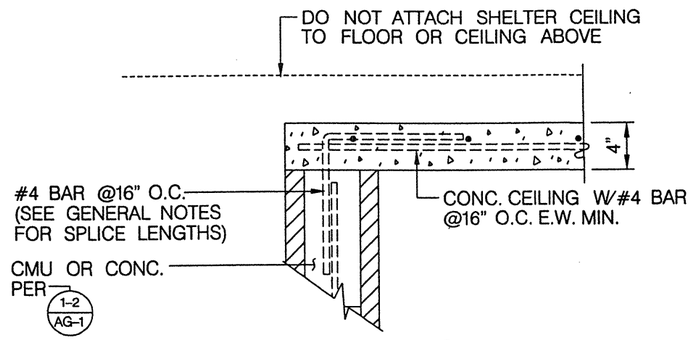
3/AG-3 CEILING EXHAUST FAN / HVAC DETAIL

SCALE: 1" = 1'-0"



3A/AG-3 CEILING EXHAUST FAN / HVAC DETAIL

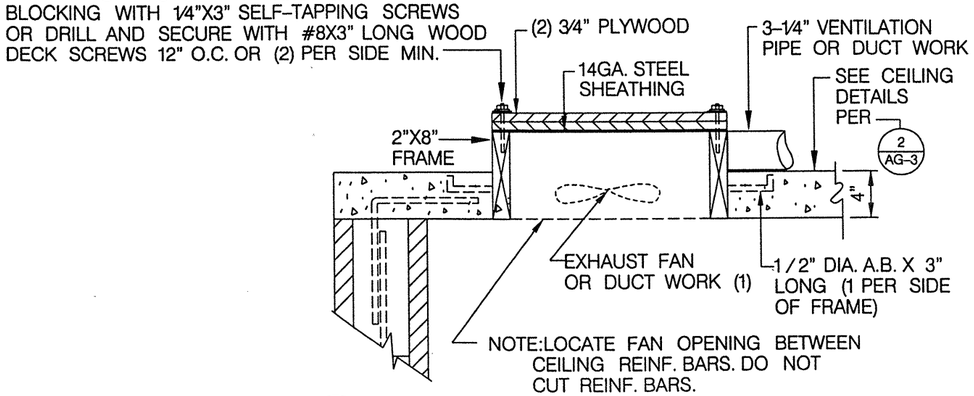
SCALE: 1" = 1'-0"



ALTERNATIVE 2 OF 2

2/AG-3 TYPICAL WALL / CEILING CONNECTION FOR CONCRETE CEILING

SCALE: 1" = 1'-0"



3B/AG-3 CEILING EXHAUST FAN / HVAC DETAIL

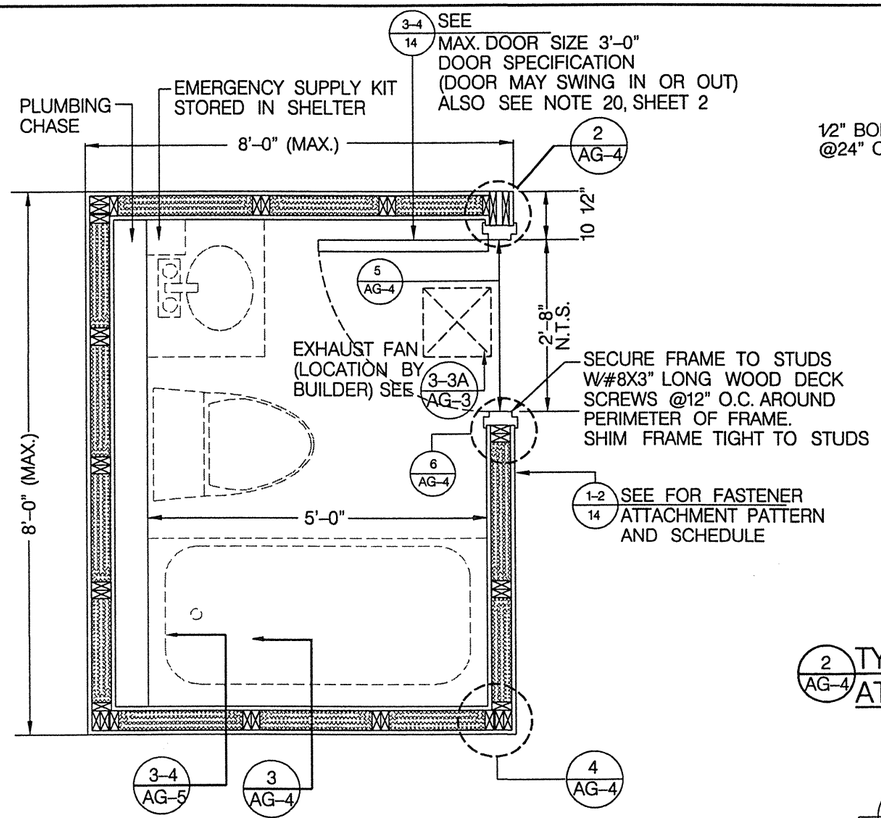
SCALE: 1" = 1'-0"

NOTE:
(1) INDICATES NORMAL EXHUAST VENTILATION OF BATHROOM OR HVAC DUCTWORK TO A ROOM. THE SHELTER DESIGN DOES NOT RELY ON THIS VENTILATION TO ENSURE OCCUPANT SAFETY.

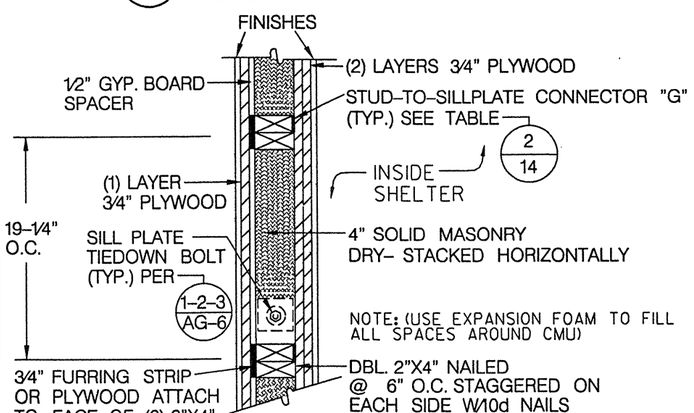
CMU/CONCRETE SECTIONS CEILING ALTERNATIVES

DRAWING NO.: AG-3	SHEET 8 OF 16
DATE: OCTOBER 1998	
REVISED: AUGUST 1999	REV. NO. 1

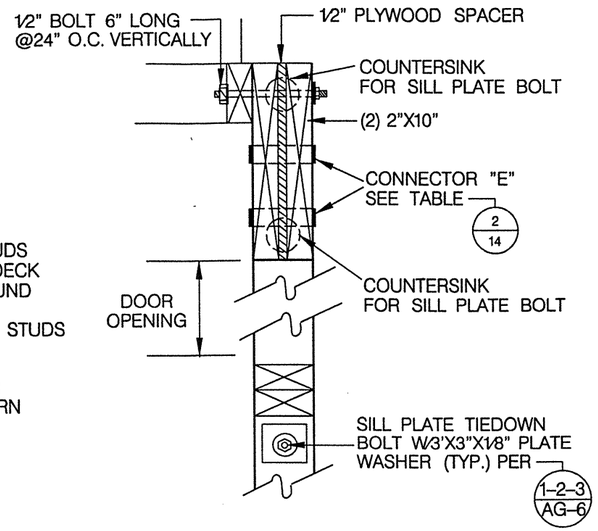
FEDERAL EMERGENCY MANAGEMENT AGENCY
MITIGATION DIRECTORATE WASHINGTON, DC



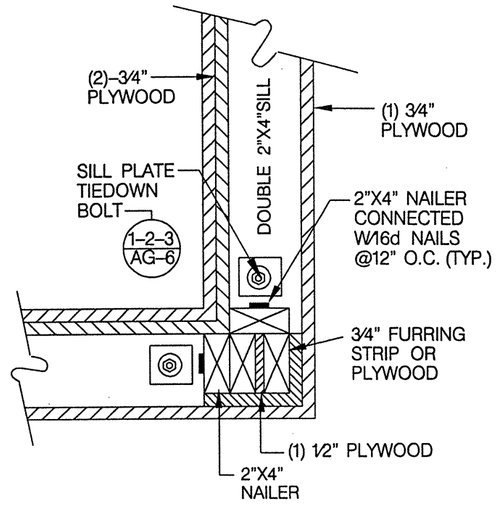
1 AG–4 TYPICAL PLAN
SCALE: 1/2" = 1'– 0"



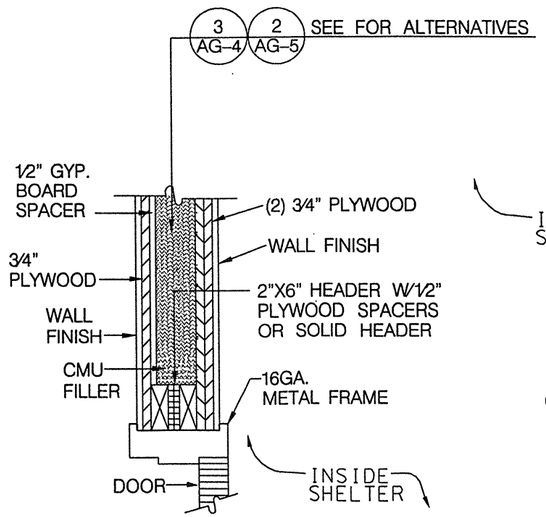
3 AG–4 EXPANDED PLAN–MASONRY INFILL WALL ALTERNATIVE
TOP VIEW
SCALE:1" = 1'–0"



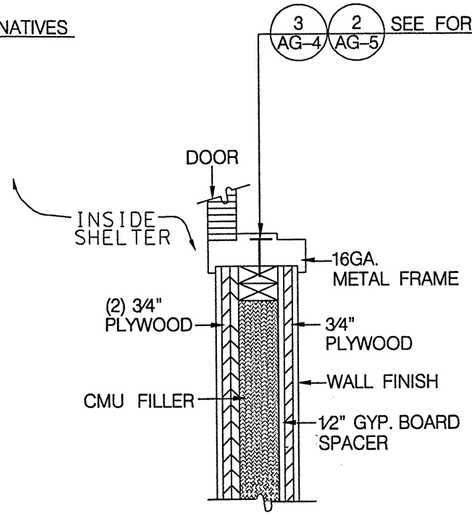
2 AG–4 TYPICAL HOLD DOWN ANCHOR DETAIL AT DOOR CORNER
TOP VIEW
SCALE: 1–1/2" = 1'–0"



4 AG–4 TYPICAL WALL CORNER DETAIL
TOP VIEW
SCALE: 1–1/2 " = 1'–0"



5 AG–4 DOOR HEAD SECTION
SCALE: 1" = 1'–0"



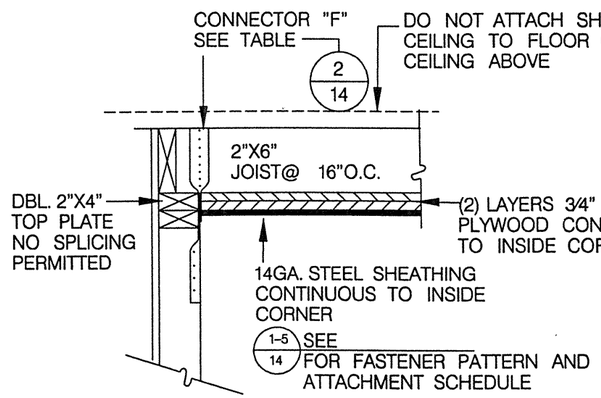
6 AG–4 DOOR JAMB
TOP VIEW
SCALE: 1" = 1'–0"

NOTE:
ALL WALL STUDS TO BE ATTACHED W/ (2) 16d NAILS TO SINGLE TOP AND BOTTOM PLATES, NAILED THROUGH FROM OUTSIDE, PRIOR TO ATTACHMENT OF SECOND TOP AND BOTTOM PLATES.

WOOD–FRAME SHELTER PLAN– PLYWOOD SHEATHING W/CMU INFILL

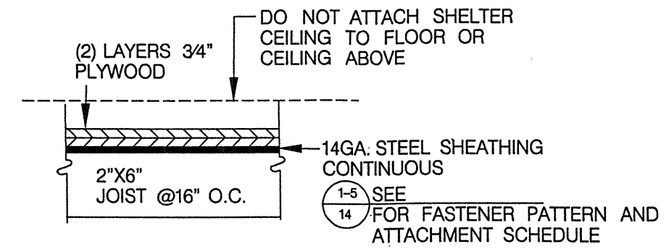
DRAWING NO.: AG–4	SHEET 9 OF 16
DATE: OCTOBER 1998	
REVISED: AUGUST 1999	REV. NO. 1

FEDERAL EMERGENCY MANAGEMENT AGENCY
MITIGATION DIRECTORATE WASHINGTON, DC



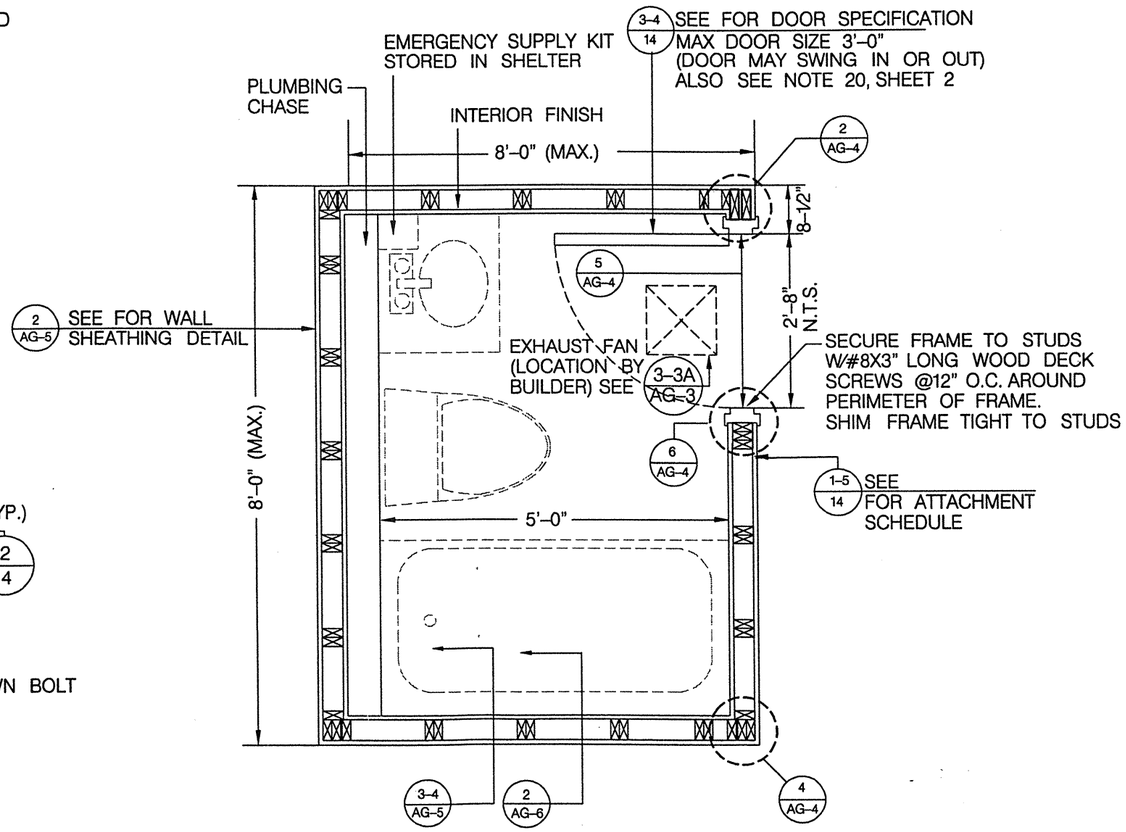
3 AG-5 ALTERNATIVE 1 CEILING PARTIAL-CEILING SECTION CONNECTION

SCALE: 1" = 1'-0"



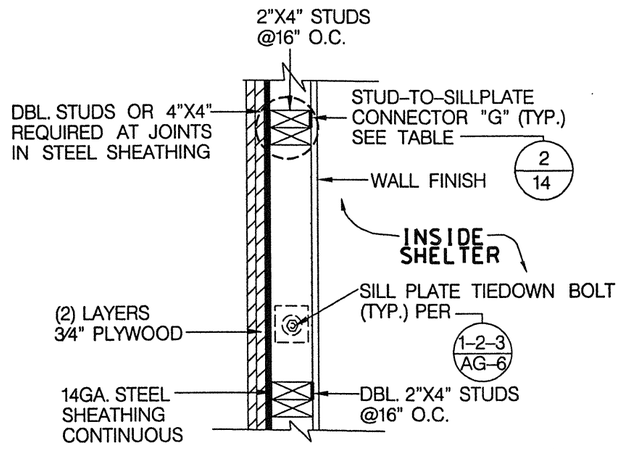
4 AG-5 ALTERNATIVE 2 CEILING

SCALE: 1" = 1'-0"



1 AG-5 TYPICAL PLAN VIEW

SCALE: 1/2" = 1'-0"



2 AG-5 WALL SECTION TOP VIEW

SCALE: 1" = 1'-0"

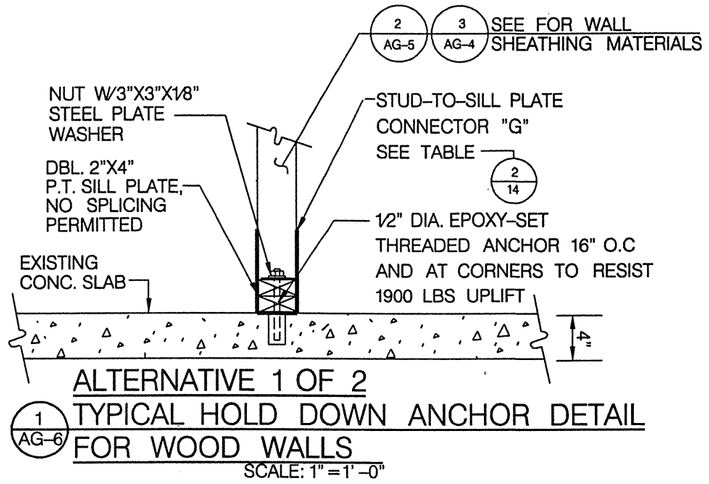
NOTES:

1. SHELTER W/ STEEL SHEATHING COVERED W/ GYP. BOARD FINISH OR OTHERWISE SEPARATED FROM CONTACT BY SHELTER OCCUPANTS NEED NOT BE GROUNDED.
2. SHELTER W/ STEEL SHEATHING UNCOVERED AND AVAILABLE FOR CONTACT BY SHELTER OCCUPANTS MUST BE GROUNDED AT A SINGLE LOCATION W/COPPER WIRE & GROUND ROD TO MEET NATIONAL ELECTRIC CODE & LOCAL REQUIREMENTS.
3. ALL WALL STUDS TO BE ATTACHED W/ (2) 16d NAILS TO SINGLE TOP AND BOTTOM PLATES, NAILED THROUGH FROM OUTSIDE, PRIOR TO ATTACHMENT OF SECOND TOP AND BOTTOM PLATES.

WOOD FRAME SHELTER PLAN-
PLYWOOD AND STEEL WALL
SHEATHING

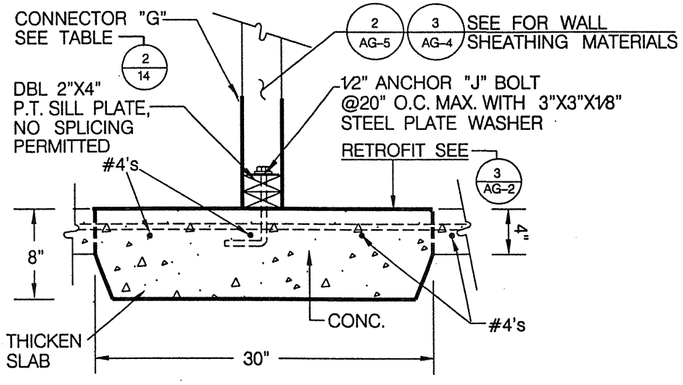
DRAWING NO.: AG-5	SHEET 10 OF 16
DATE: OCTOBER 1998	
REVISED: AUGUST 1999	REV. NO.1

FEDERAL EMERGENCY MANAGEMENT AGENCY
MITIGATION DIRECTORATE WASHINGTON, DC



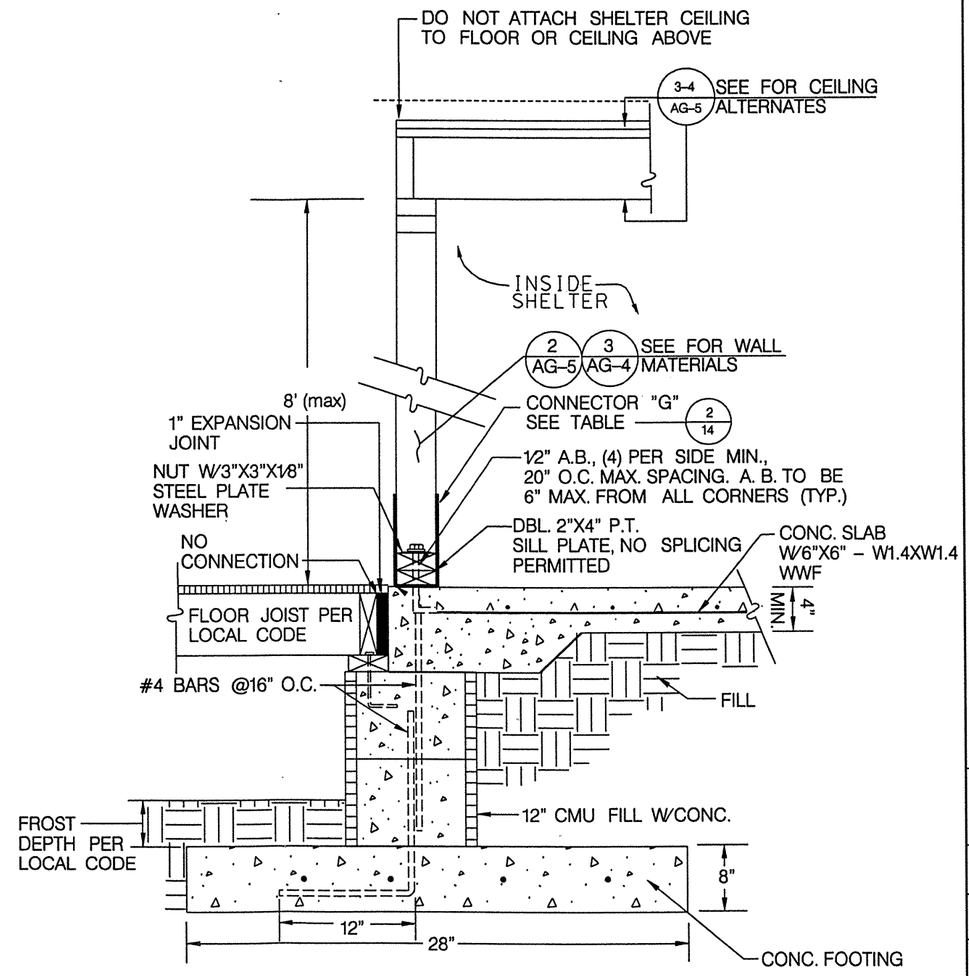
ALTERNATIVE 1 OF 2
1 AG–6 TYPICAL HOLD DOWN ANCHOR DETAIL FOR WOOD WALLS

SCALE: 1" = 1'–0"



ALTERNATIVE 2 OF 2
2 AG–6 TYPICAL ANCHOR DETAIL NEW SLAB–ON–GRADE FOUNDATION WITH WOOD WALLS

SCALE: 1" = 1'–0"



3 AG–6 ANCHOR DETAIL FOR CRAWL SPACE FOUNDATION WITH WOOD WALLS

SCALE: 1" = 1'–0"

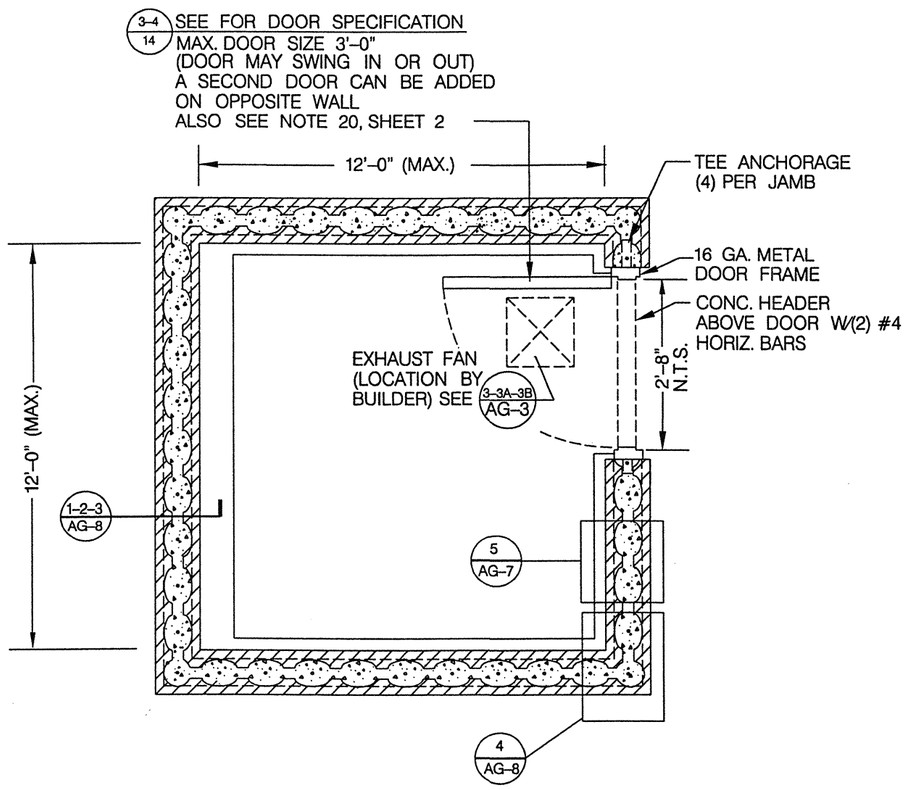
NOTES:

1. TO OBTAIN FULL A.B. PULLOUT RESISTANCE, THE BOTTOM OF THE DRILLED HOLE FOR A.B. SHOULD BE NO CLOSER THAN 1/2" TO THE BOTTOM OF THE CONC. SLAB.
2. A PILOT HOLE SHOULD BE DRILLED TO DETERMINE THE MAX. EMBEDMENT LENGTH.

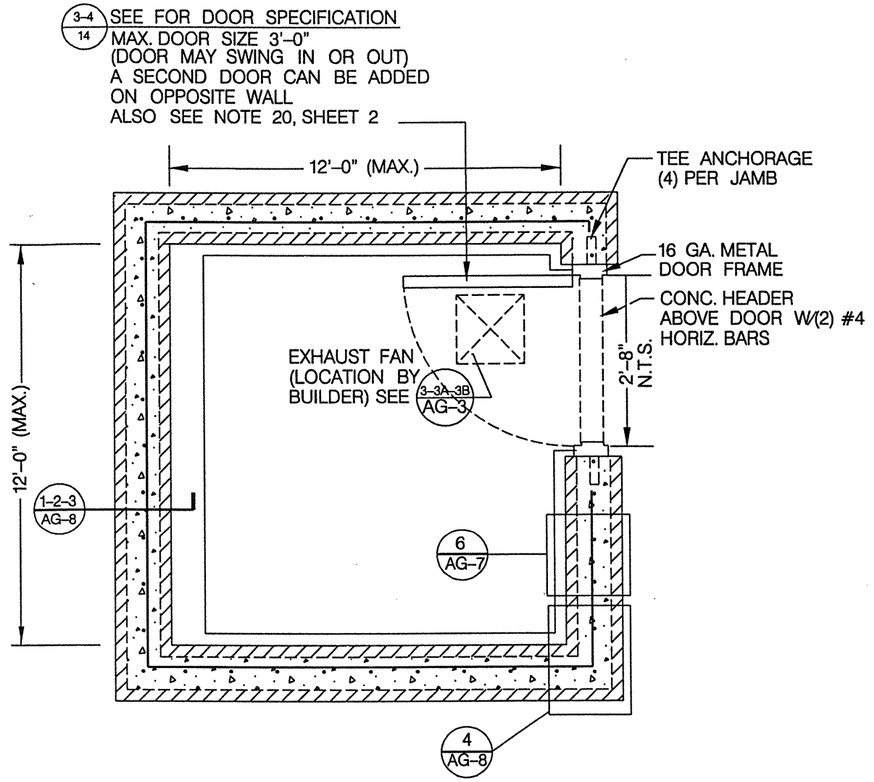
WOOD–FRAME SHELTER – FOUNDATION SECTIONS

DRAWING NO.: AG–6	SHEET 11 OF 16
DATE: OCTOBER 1998	
REVISED: AUGUST 1999	REV. NO. 1

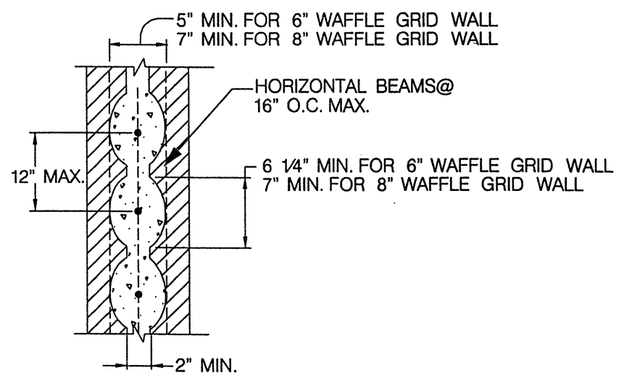
FEDERAL EMERGENCY MANAGEMENT AGENCY
MITIGATION DIRECTORATE WASHINGTON, DC



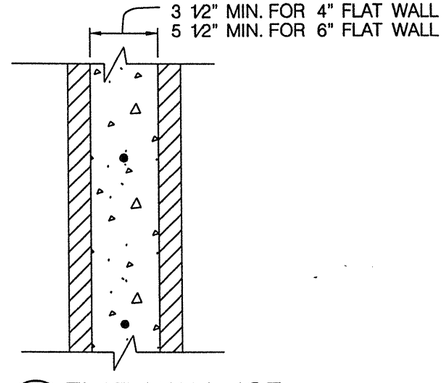
1 AG-7 WAFFLE GRID ICF SYSTEM PLAN
SCALE: 1/2" = 1'-0"



2 AG-7 FLAT WALL ICF SYSTEM PLAN
SCALE: 1/2" = 1'-0"



5 AG-7 WAFFLE GRID ICF
SCALE: 1" = 1'-0"

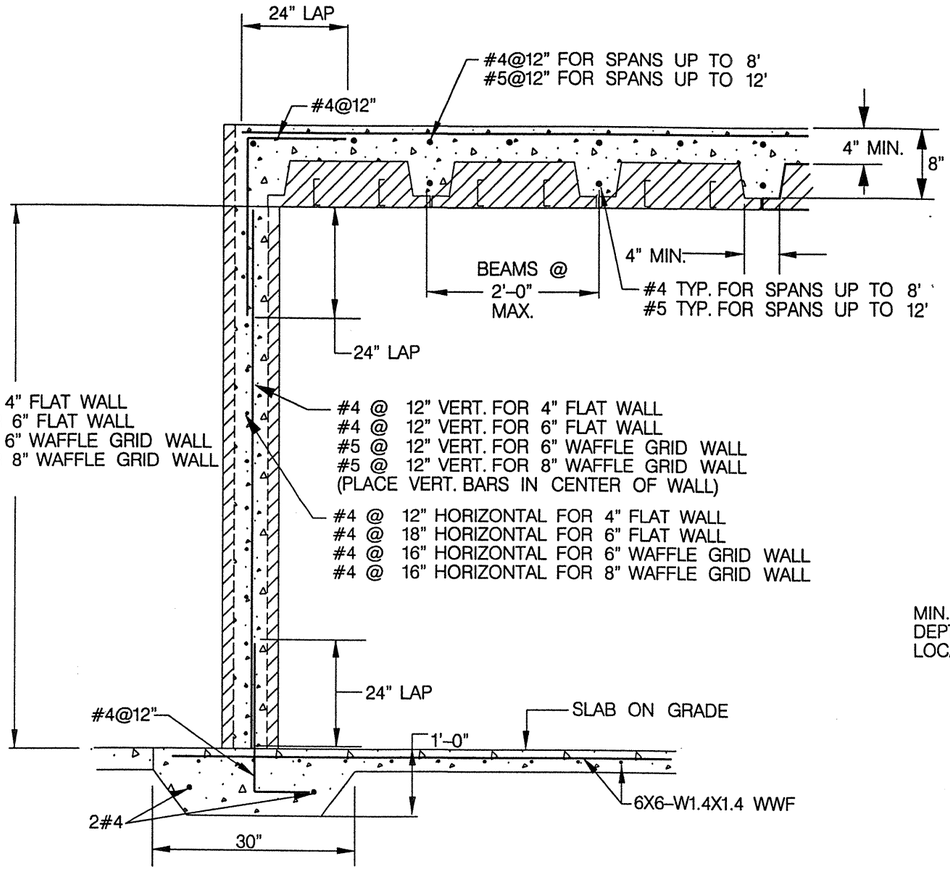


6 AG-7 FLAT WALL ICF
SCALE: 1" = 1'-0"

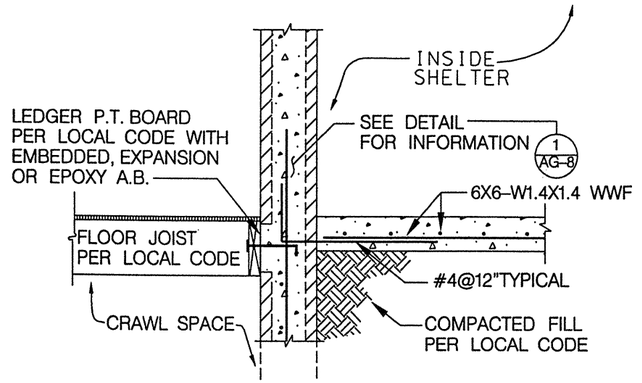
INSULATING CONCRETE FORM-PLANS

DRAWING NO.:AG-7	SHEET 12 OF 16
DATE: AUGUST 1999	

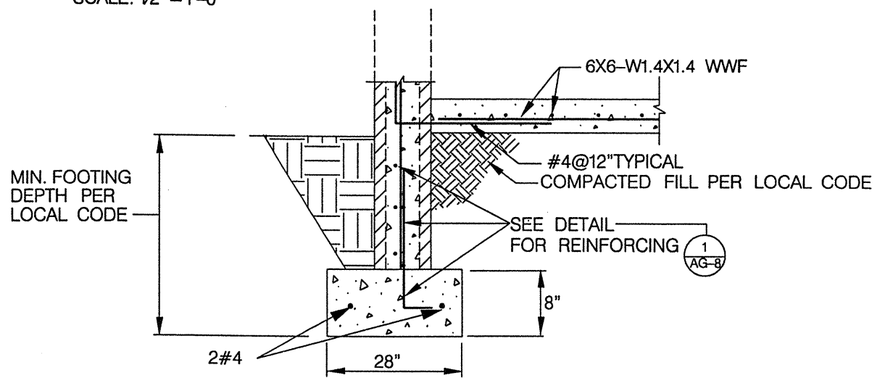
FEDERAL EMERGENCY MANAGEMENT AGENCY
MITIGATION DIRECTORATE WASHINGTON, DC



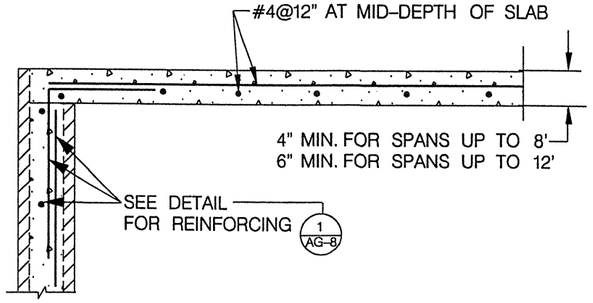
1 AG-8 INTERIOR WALL DETAIL
SCALE: 1/2" = 1'-0"



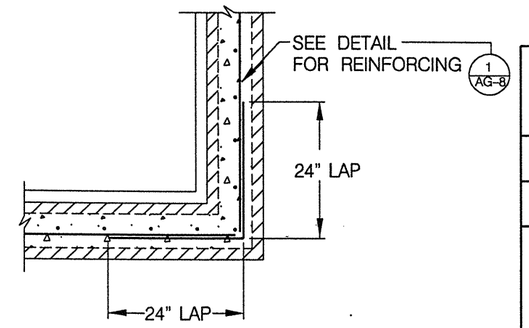
FLOOR CONNECTION DETAIL-CRAWLSPACE FOUNDATION
SCALE: 1/2" = 1'-0"



2 AG-8 FOOTING DETAIL - EXTERIOR WALLS
SCALE: 1/2" = 1'-0"



3 AG-8 ALTERNATIVE ROOF DETAIL
SCALE: 1/2" = 1'-0"



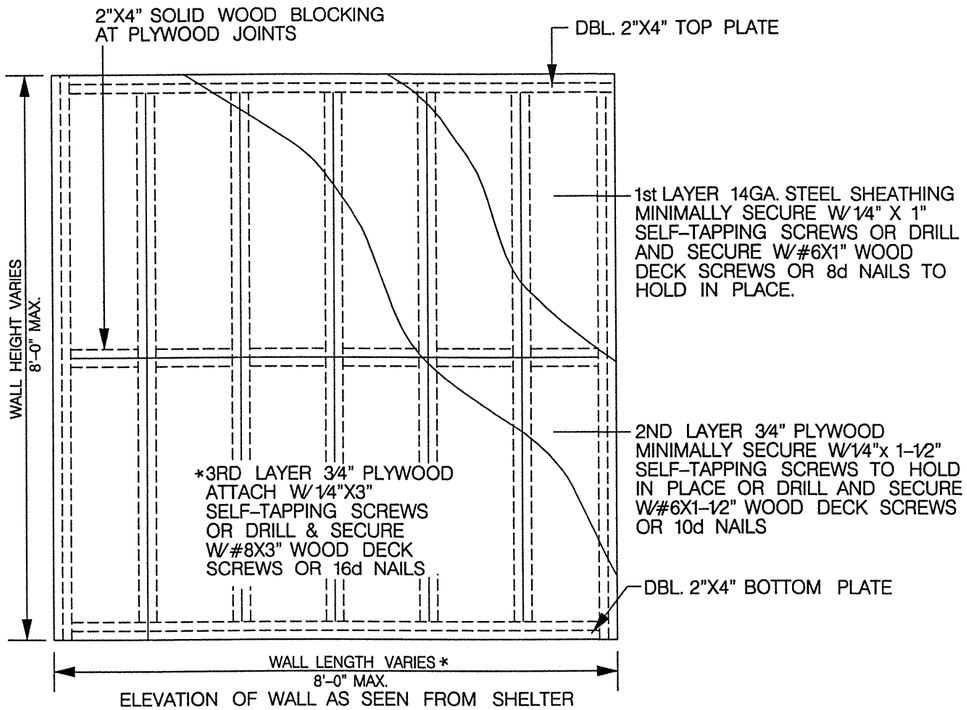
4 AG-8 TYPICAL CORNER DETAIL
SCALE: 1/2" = 1'-0"

INSULATING CONCRETE FORM-SECTIONS

DRAWING NO.:AG-8 | SHEET 13 OF 16

DATE: AUGUST 1999

FEDERAL EMERGENCY MANAGEMENT AGENCY
MITIGATION DIRECTORATE WASHINGTON, DC



ELEVATION OF WALL AS SEEN FROM SHELTER EXTERIOR

1/14 PLYWOOD SHEATHING ATTACHMENT PATTERN

SCALE: 1/2" = 1'-0"

NOTES:

1. *ATTACHMENT SCHEDULE VARIES BASED ON WALL LENGTH SEE TABLE FOR ATTACHMENT SCHEDULE — 5/14
2. INSTALL PLYWOOD HORIZONTALLY
3. MINIMUM UNBROKEN WALL LENGTH IS 3'-6"

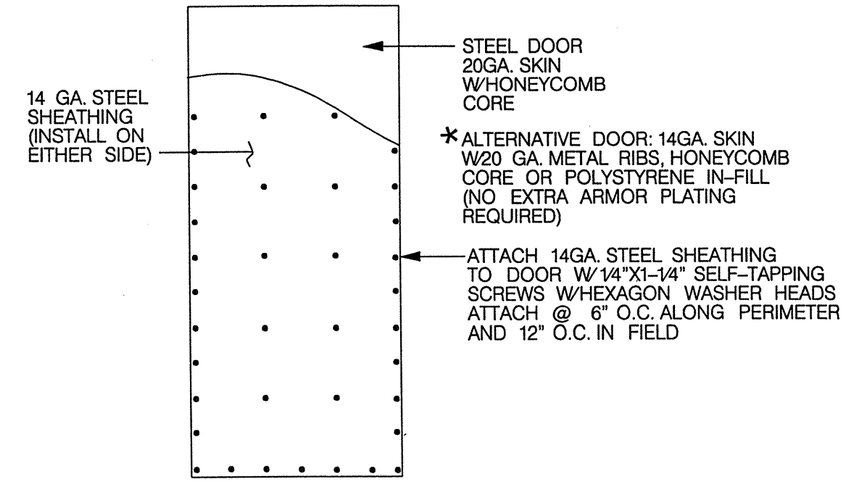
2/14 CONNECTOR SCHEDULE

LOCATION	REQUIRED UPLIFT CAPACITY(LB)	SIMPSON STRONG-TIE	SEMCO	KANT-SAG
A	375	H7	RTPGA814	RT20
B	375	LSTA15	RTP20812	LSTA15
C	1,700	H6	TPP4	SP2
D	2,750	PAHD42	RTP42	PAHD42
E	600	SP4	TPP4	SP2
F	1,700	H6	TPP4	SP2
G	1,700	H6	TPP4	SP2
H	1,700	PAI18		PA18

NOTES:
BECAUSE NOT ALL CONTRACTORS ARE FAMILIAR WITH THE TYPE OF STRUCTURAL CONNECTORS SHOWN IN THESE DRAWING, THE NAMES OF SOME COMPANIES THAT MANUFACTURE CONNECTORS HAVE BEEN INCLUDED IN THIS TABLE. THE LIST OF COMPANIES IS NOT, HOWEVER, EXHAUSTIVE. ADDITIONALLY, THIS LIST IS NOT INTENDED TO EXPRESS A PREFERENCE FOR THOSE MANUFACTURERS AND/OR THEIR PRODUCTS BY THE UNITED STATES GOVERNMENT NOR IS IT AN ENDORSEMENT OF THOSE MANUFACTURERS AND/OR THEIR PRODUCTS.

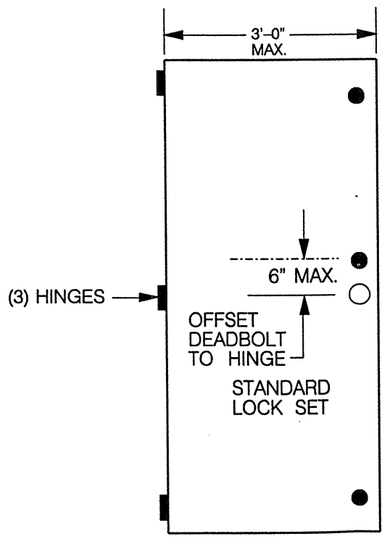
WALL LENGTH	16d NAILS	#8X3" WOOD DECK SCREWS	1/4" X 3" SELF TAPPING SCREWS
3'-6" TO 5'-0"	2" O.C. @ EDGES 6" O.C. IN FIELD	2" O.C. @ EDGES 6" O.C. IN FIELD	3" O.C. @ EDGES 6" O.C. IN FIELD
5'-1" TO 7'-0"	3" O.C @ EDGES 6" O.C. IN FIELD	3" O.C @ EDGES 6" O.C. IN FIELD	4" O.C @ EDGES 6" O.C. IN FIELD
7'-1" TO 8'-0"	4" O.C. @ EDGES 6" O.C. IN FIELD	4" O.C. @ EDGES 6" O.C. IN FIELD	6" O.C. @ EDGES 6" O.C. IN FIELD

5/14 ATTACHMENT SCHEDULE



4/14 DOOR – SHEET METAL ATTACHMENT PATTERN

SCALE: 1/2" = 1'-0"



(3) RESIDENTIAL STANDARD. QUALITY MORTISED DEADBOLTS WITH 3/8" MIN. DIA. PINS W/1" THROW LOCATE OPPOSITE HINGES

3/14 DOOR ATTACHMENT DETAILS

SCALE: 1/2" = 1'-0"

MISC. DETAILS

DRAWING NO.: 14	SHEET 14 OF 16
DATE: OCTOBER 1998	
REVISED: AUGUST 1999	REV. NO. 1

FEDERAL EMERGENCY MANAGEMENT AGENCY
MITIGATION DIRECTORATE WASHINGTON, DC

SHELTER: LEAN-TO

WALL MATERIALS

MATERIAL	SIZE	MEASURE	QUANTITY	REMARKS
SYP. LUMBER	2" X 4" X 8'	EACH	26	
SYP. LUMBER	2" X 4" X 12'	EACH	2	
P.T. LUMBER	2" X 4" X 8'	EACH	4	
P.T. LUMBER	2" X 6" X 8'	EACH	1	
SYP. LUMBER	2" X 8" X 8'	EACH	1	
SYP. LUMBER	2" X 6" X 12'	EACH	9	
PLYWOOD	3/4"	4' X 8' SHEET	11	
STEEL SHEATHING	14 GA.	4' X 8' SHEET	7	

HARDWARE

MATERIAL	DIAMETER	LENGTH	MEASURE	QUANTITY	REMARKS
DOOR			EACH	1	MADE ON SITE
HINGES		MIN. 3/1/2" LONG	EACH	3	SEE ITEM 3 ON SHEET 14
SLIDE BOLTS/ DEAD BOLTS			EACH	3	SEE ITEM 3 ON SHEET 14
ANCHOR BOLTS	1/2"	MIN. 2-1/8" EMBED.	EACH	20	SEE DETAIL 4 ON SHEET 4
TYPE "A" CONNECTORS			EACH	9	SEE ITEM 2 ON SHEET 14
TYPE "B" CONNECTORS			EACH	9	SEE ITEM 2 ON SHEET 14

SHELTER: CMU WALL ON SLAB-ON-GRADE

WALLS

MATERIAL	SIZE	MEASURE	QUANTITY	REMARKS
HOLLOW CMU	6" X 8" X 16"	EACH	240	W/ CONCRETE GROUT
REINFORCING BAR	#4	LINEAR FEET	368	
MORTAR MIX	80 LB	BAG	10	

SLAB-ON-GRADE FOUNDATION

MATERIAL	SIZE	MEASURE	QUANTITY	REMARKS
REINFORCING BAR	#4 X 3'	EACH	19	BENT 2' X 1'
REINFORCING BAR	#4 X 8"	LINEAR FEET	100	
CONCRETE		CUBIC YARDS	2	

ALTERNATIVE (1) REINFORCED CONCRETE CEILING

MATERIAL	SIZE	MEASURE	QUANTITY	REMARKS
REINFORCING BAR	#4 X 4'	EACH	19	BENT 2' X 2'
REINFORCING BAR	#4 X 8'	LINEAR FEET	14	
CONCRETE		CUBIC YARDS	1	

ALTERNATIVE (2) WOOD-FRAME CEILING

MATERIAL	SIZE	MEASURE	QUANTITY	REMARKS
SYP. LUMBER	2" X 6" X 8'	EACH	10	
PLYWOOD	3/4"	4' X 8' SHEET	4	
STEEL SHEATHING	14 GA.	4' X 8' SHEET	2	

HARDWARE

MATERIAL	MEASURE	QUANTITY	REMARKS
DEADBOLTS	EACH	3	SEE ITEM 3 ON SHEET 14
DOORFRAME	EACH	1	SEE DETAIL 1 ON SHEET 6
DOOR	EACH	1	SEE ITEMS 3 AND 4 ON SHEET 14
TYPE "D" CONNECTOR*	EACH	20	SEE ITEM 2 ON SHEET 14

* REQUIRED ONLY FOR ALTERNATIVE (2) WOOD-FRAME CEILING

CHASE WALL

MATERIAL	SIZE	MEASURE	QUANTITY	REMARKS
P.T. LUMBER	2" X 6" X 8'	EACH	1	
SYP. LUMBER	2" X 6" X 8'	EACH	10	

SHELTER: CONCRETE WALL ON SLAB-ON-GRADE

WALLS

MATERIAL	SIZE	MEASURE	QUANTITY	REMARKS
CONCRETE		CUBIC YARD	5	
REINFORCING BAR	#4	LINEAR FEET	520	

SLAB-ON-GRADE FOUNDATION

MATERIAL	SIZE	MEASURE	QUANTITY	REMARKS
REINFORCING BAR	#4 X 3'	EACH	19	BENT 2' X 1'
REINFORCING BAR	#4 X 8'	LINEAR FEET	100	
CONCRETE		CUBIC YARD	2	

ALTERNATIVE (1) REINFORCED CONCRETE CEILING

MATERIAL	SIZE	MEASURE	QUANTITY	REMARKS
REINFORCING BAR	#4 X 4'	EACH	19	BENT 2' X 2'
REINFORCING BAR	#4 X 8'	LINEAR FEET	14	
CONCRETE		CUBIC YARD	1	

ALTERNATIVE (2) WOOD-FRAME CEILING

MATERIAL	SIZE	MEASURE	QUANTITY	REMARKS
SYP. LUMBER	2" X 6" X 8'	EACH	10	
PLYWOOD	3/4"	4' X 8' SHEET	4	
STEEL SHEATHING	14 GA.	4' X 8' SHEET	2	

HARDWARE

MATERIAL	MEASURE	QUANTITY	REMARKS
DEADBOLTS	EACH	3	SEE ITEM 3 ON SHEET 14
DOORFRAME	EACH	1	SEE DETAIL 2 ON SHEET 6
DOOR	EACH	1	SEE ITEMS 3 AND 4 ON SHEET 14
TYPE "D" CONNECTOR*	EACH	20	SEE ITEM 2 ON SHEET 14

* REQUIRED ONLY FOR ALTERNATIVE (2) WOOD-FRAME CEILING

CHASE WALL

MATERIAL	SIZE	MEASURE	QUANTITY	REMARKS
P.T. LUMBER	2" X 6" X 8'	EACH	1	
SYP. LUMBER	2" X 6" X 8'	EACH	10	

NOTE: ALL QUANTITIES SHOWN ARE BASED ON AN 8'X8'X8' SHELTER.

MATERIALS LISTS

DRAWING NO.: 15 | SHEET 15 OF 16

DATE: OCTOBER 1998

REVISED: AUGUST 1999 | REV. NO. 1

FEDERAL EMERGENCY MANAGEMENT AGENCY
MITIGATION DIRECTORATE WASHINGTON, DC

SHELTER: INSULATING CONCRETE FORMS ON SLAB - ON -GRADE

INSULATING CONCRETE FORMS - FLAT WALL ALTERNATIVE

MATERIAL	SIZE	MEASURE	QUANTITY	REMARKS
FORMS		SQUARE FEET	256	
CONCRETE 4" FLAT WALL		CUBIC YARDS	3	
CONCRETE 6" FLAT WALL		CUBIC YARDS	5	
REINFORCING BARS 4" FLAT WALL	#4	LINEAR FEET	672	
REINFORCING BARS 6" FLAT WALL	#4	LINEAR FEET	528	

INSULATING CONCRETE FORMS-WAFFLE GRID WALL ALTERNATIVE

MATERIAL	SIZE	MEASURE	QUANTITY	REMARKS
FORMS		SQUARE FEET	256	
CONCRETE 6" WAFFLE GRID WALL		CUBIC YARDS	3.5	
CONCRETE 8" WAFFLE GRID WALL		CUBIC YARDS	5	
REINFORCING BARS	#4 #5	LINEAR FEET LINEAR FEET	416 256	

SLAB-ON-GRADE FOUNDATION

MATERIAL	SIZE	MEASURE	QUANTITY	REMARKS
CONCRETE		CUBIC YARDS	2	
REINFORCING BARS	#4	LINEAR FEET	192	

INSULATING CONCRETE FORM ROOF ALTERNATIVE

MATERIAL	SIZE	MEASURE	QUANTITY	REMARKS
FORMS		SQUARE FEET	64	
CONCRETE		CUBIC YARDS	1	
REINFORCING BARS	#4 #5	LINEAR FEET LINEAR FEET	128 32	

FLAT CONCRETE ROOF ALTERNATIVE

MATERIAL	SIZE	MEASURE	QUANTITY	REMARKS
CONCRETE		CUBIC YARDS	1	
REINFORCING BARS	#4	LINEAR FEET	128	

HARDWARE

MATERIAL	SIZE	MEASURE	QUANTITY	REMARKS
DEADBOLTS		EACH	3	SEE ITEM 3 ON SHEET 14
DOORFRAME		EACH	1	SEE DETAIL 1 ON SHEET 6
DOOR		EACH	1	SEE ITEMS 3 AND 4 ON SHEET 14

SHELTER: WOOD-FRAME WITH CMU INFILL WALL ON SLAB-ON-GRADE

WALLS

MATERIAL	SIZE	MEASURE	QUANTITY	REMARKS
SYP. LUMBER	2" X 4" X 8'	EACH	38	
P.T. LUMBER	2" X 4" X 8'	EACH	4	
SYP. LUMBER	2" X 6" X 8'	EACH	1	
PLYWOOD	3/4"	4' X 8' SHEET	24	
SOLID BLOCK	4" X 8" X 16"	EACH	128	DRY - STACK
SYP. LUMBER	2" X 8" X 10"	EACH	2	
SYP. LUMBER	1" X 4" X 8'	EACH	19	

CEILING

MATERIAL	SIZE	MEASURE	QUANTITY	REMARKS
SYP. LUMBER	2" X 6" X 8'	EACH	10	
PLYWOOD	3/4"	4" X 8" SHEET	4	
STEEL SHEATHING	14 GA.	4' X 8' SHEET	2	

HARDWARE

MATERIAL	DIAMETER	LENGTH	MEASURE	QUANTITY	REMARKS
DOOR FRAME			EACH	1	SEE DETAILS 5 AND 6 ON SHEET 9
DOOR			EACH	1	SEE ITEMS 3 AND 4 ON SHEET 14
ANCHOR BOLTS	1/2"	MIN. 2-1/8" EMBED.	EACH	25	
TYPE "E" CONNECTORS			EACH	2	SEE ITEM 2 ON SHEET 14
TYPE "F" CONNECTORS			EACH	14	SEE ITEM 2 ON SHEET 14
TYPE "G" CONNECTORS			EACH	14	SEE ITEM 2 ON SHEET 14
DEADBOLTS			EACH	3	SEE ITEM 3 ON SHEET 14
16D NAILS			LB	20	

CHASE WALL

MATERIAL	SIZE	MEASURE	QUANTITY	REMARKS
P.T. LUMBER	2" X 6" X 8'	EACH	1	
SYP. LUMBER	2" X 6" X 8'	EACH	10	

SHELTER: WOOD-FRAME WITH PLYWOOD AND STEEL SHEATHING WALL ON SLAB-ON-GRADE

WALLS

MATERIAL	SIZE	MEASURE	QUANTITY	REMARKS
SYP. LUMBER	2" X 4" X 8'	EACH	58	
P.T. LUMBER	2" X 4" X 8'	EACH	4	
PLYWOOD	3/4"	4' X 8' SHEET	16	
STEEL SHEATHING	14 GA.	4' X 8' SHEET	8	
SYP. LUMBER	2" X 10" X 8'	EACH	2	
SYP. LUMBER	2" X 6" X 8'	EACH	1	

CEILING

MATERIAL	SIZE	MEASURE	QUANTITY	REMARKS
SYP. LUMBER	2" X 6" X 8'	EACH	10	
PLYWOOD	3/4"	4' X 8' SHEET	4	
STEEL SHEATHING	14 GA.	4' X 8' SHEET	2	

HARDWARE

MATERIAL	DIAMETER	LENGTH	MEASURE	QUANTITY	REMARKS
DOOR FRAME			EACH	1	SEE DETAILS 5 AND 6 ON SHEET 9
DOOR			EACH	1	SEE ITEMS 3 AND 4 ON SHEET 14
ANCHOR BOLTS	1/2"	MIN. 2-1/8" EMBED.	EACH	25	
TYPE "E" CONNECTORS			EACH	2	SEE ITEM 2 ON SHEET 14
TYPE "F" CONNECTORS			EACH	14	SEE ITEM 2 ON SHEET 14
TYPE "G" CONNECTORS			EACH	14	SEE ITEM 2 ON SHEET 14
DEADBOLTS			EACH	3	SEE ITEM 3 ON SHEET 14
16D NAILS			LB.	20	

CHASE WALL

MATERIAL	SIZE	MEASURE	QUANTITY	REMARKS
P.T. LUMBER	2" X 6" X 8'	EACH	1	
SYP. LUMBER	2" X 6" X 8'	EACH	10	

NOTE: ALL QUANTITIES SHOWN ARE BASED ON AN 8'X8'X8' SHELTER.

MATERIALS LISTS

DRAWING NO.: 16 | SHEET 16 OF 16

DATE: OCTOBER 1998

REVISED: AUGUST 1999 | REV. NO. 1

FEDERAL EMERGENCY MANAGEMENT AGENCY
MITIGATION DIRECTORATE WASHINGTON, DC